THE

INDIA REVIEW

AND

JOURNAL OF FOREIGN SCIENCE

AND THE ARTS.

EDITED BY

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AS WE SHALL ALWAYS BE CONSCIOUS THAT OUR MISTAKES ARE INVOLUNTARY, WE SHALL WATCH THE GRADUAL DISCOVERIES OF TIME, AND RETRACT WHATEVER WE HAVE HASTILY AND ERRONEOUSLY ADVANCED. *Johnson.*

VOL. I.

CALCUTTA:

PRINTED AND PUBLISHED BY G. WOOLLASTON, AND SOLD BY MR. HUSBAND, ALLAHABAD; MR. PHAROAH, MOUNT ROAD, MADRAS; AND MR. MALVERY, MEADOW STREET, BOMBAY.

1837.

Presented to the
ROYAL ASIATIC SOCIETY
by the Editor
3 Nov 1830

Chas. W. Richmond.
Aug. 30, 1906.

PREFACE.

A year has now elapsed since we commenced the periodical the first volume of which is completed. The grounds on which we ventured on this scientific enterprize were not derived from a belief of our own fitness, for such an undertaking; but from the circumstance that others, possessing superior talent, greater erudition, and being better adapted in every respect than ourselves, had not come forward: and when on the one hand, we took into consideration the vast extent of this empire, and the strides which education was making among all classes of the people, and on the other, that no work, calculated to diffuse the light which discoveries and improvements in Europe were hourly shedding through the medium of science and the arts, had been offered to the public; we considered ourselves justified in stepping forward, humble as our pretensions were, to prove the utility of a Journal exclusively devoted to the review of works on science, embracing foreign science and the arts; and, by shewing the extensive influence which their dissemination must necessarily have in promoting the welfare of this country, and laying open those resources of knowledge which at all times have formed the basis of national power and prosperity, endeavour to awaken a general spirit of research. We had another object in view. There are at the present moment upwards of 700 accomplished and highly educated medical men scattered over the vast territories of our eastern possessions. The duties of many consist in simply attending a few sick in a solitary hospital, and the British Government of India has not yet discovered the admirable advantages which would accrue from employing these able men out of the immediate sphere of their profession. Now there is scarcely a medical man in India who has not acquired some knowledge of chemistry—a knowledge which, it does not require much penetration and ingenuity to prove, might be applied to improve the arts and manufactories now going on, in the great cities and marts in this country. What soil in the whole world is so rich in productions as this, and so calculated to yield all that is now obtained from foreign countries? Observe what the genius of chemical science has done for France and England, and what may it not do for India!

We are aware that we might be charged with encouraging an indulgence in speculative refinement, which has in some instances led men out of the line of useful industry, and, by the loss of property, to the ruin of their families. Such has been the result, it is true; but, generally speaking, to the artist only, seldom to the man of science. The chemist is better able than one who is only a mechanic to predict, from an experiment on a small scale, the probable issue of more extensive attempts. Watt, by a clear insight into the doctrine of latent heat, resulting from his thorough knowledge of chemistry, and seconded by mechanical skill, taught the way to bring the steam engine into

perfection. Wedgewood, by the same knowledge, advanced the arts of manufacturing porcelain; neither must we forget Scheele's discovery of oxygenized muriatic acid, and Bethollet's instructions in its application to the art of bleaching, nor Sequin's and Davy's chemical processes, which brought into perfection the art of tanning and preparation of leather. Chemistry is the foundation of those arts which furnish us with saline substances, an order of bodies highly useful in the affairs of common life. The successful manufactory of glass and various kinds of pottery depend upon a knowledge of the nature of the substances employed, of their fusibility, as affected by difference of proportion, or by the admixture of foreign substances, and of the means of regulating and measuring high degrees of heat. The chemist Bergman taught the most successful manufactory of brick and tiles. The art of malting is most successfully taught by the chemist. Dyeing and printing, as we have already shewn, are a tissue of chemical operations, and in short we should tire our readers by giving further illustration, to shew the utility of this department of our labours to medical men who are generally chemists. If national prosperity in Britain has arisen, in an eminent degree, from a superiority in the production of her arts, ought they, we enquire, to be neglected in British India? If not, we may boldly put the question—were we not, as having the welfare of India at heart, bound to promote it by a due discharge of our duty, by diffusing discoveries in the mechanical arts, among medical men as the means of communicating them to the natives?

The character of our work differs however from any other of a similar kind in the variety of its objects; possessing as it does the character of Thomson's *Records of Science*, and Jameson's *Philosophical Journal*, it also assumes the appearance of the *Mechanics' Magazine*, and *Repertory of Inventions and Arts*, as well as a Review of Science in India, and Register of new discoveries. Our reason for giving to our periodical this character proceeded from our knowledge, that recently six Scientific Journals were published in Great Britain: these have been reduced to two; one of which is published monthly in London, the other quarterly in Edinburgh. Since 1835, an additional work has been published, viz., "Records of Science; and since then, another on Popular Science: how long these last ably-conducted Journals will exist, it is impossible to say; but it is obvious, there must be some cause for this want of success in works of science. We ourselves believe the cause to have arisen, from the articles having generally been too abstruse and subtle. It is true, they were full of refined and speculative knowledge and recondite reasoning; replete with physical and metaphysical subjects; but, then they were more adapted to the deep thinking philosopher, than to the general scientific reader: hence a want of subscribers. This failure in Britain of periodicals which have been devoted solely to the diffusion of general science, was a warning to us to consider well the grounds on which we anticipated success in our new undertaking. In a country like India where

the British sojourners and their descendants are comparatively few, the means of education as regards science is but in its infancy; and therefore the importance of periodicals, purely on the mere abstract branches of science, is not felt. It is principally on this account that we determined to blend with purely scientific matter, articles on the mechanical arts, and such other interesting subjects as regard improvement in manufactures, commerce, agriculture, &c., in order to suit the taste and promote the benefit of all classes, by which we should be able to admit subjects which embrace abstruse investigation into the causes of physical changes, and determine the nature of bodies, reducing them to their elements, ascertaining their mutual actions and relation, and to apply the knowledge, thus ascertained by demonstrative science, to the improvement of arts which supply the wants as well as the comforts of life.

The grave philosopher and the man of science may not delight in articles of the former description; but, by attending to our explanations, he would find that our object is to secure extensive circulation, tending greatly to support that portion of our work which is to be devoted to the latter articles which he desires to see. Our great object was to be the means of leading to important local and national improvements of promoting traffic by rivers, roads, and canals, by steam communication and rail-road transit; in which to excite individual enterprize for large interest on capital, and to shew that such improvements call imperatively for the immediate attention of Government for liberal appropriations. That stupendous machine, the steam engine, has already undergone in its progress more than two hundred different modifications. It was our desire to give every new improvement in their motive forces from water, ether, alcohol, essential oils, the liquifiable gases, atmospheric air, &c. The preparation of that invaluable and important metal, the chief material of nearly all machinery—iron, as well as the various manipulations and mechanism employed in the great staple commodities, cotton, silk, woollen, and linen; the construction of engines, mills, railways, carriages, ships, boats, docks, canals, bridges, furnaces, boilers, gas machinery, looms, presses, pumps, paddles, ploughs, water works, illustrated by lithographic sketches, together with an account of the various important processes of dyeing, distilling, bleaching, brewing, and tanning. While to the chemist and mechanic we hope to be of essential service, we shall do our utmost to meet the wishes of the naturalist. The extravagant price of standard works in this department has been to discourage the naturalist in his interesting study. We have been able to glean from the numerous works which have been published, and from papers in the transactions of learned societies during the past year, all that is novel and valuable for this class of our readers.

The question remaining to be considered next is, what benefit will such intelligence afford to a country like this, containing 1,116,000 square miles, equal in size to Great Britain, France, Spain, Portugal, Italy, Germany, Hungary, Poland, and Turkey, put together; the number of people who inhabit it being computed at 100,000,000 souls. When the riches of other countries have

been ascertained and made known through the chemist and geologist, may we not reasonably expect that they will excite a spirit of enquiry, and a desire for scientific education in the people here; and that they will soon learn, that this is the largest empire in the world,—the repository of the most valuable and precious ores,—the greatest repository of diamonds hitherto discovered; a country rich in spices, drugs, colours, silk, cotton, saltpetre, saffron, coffee, sugar, rice, &c.; that its manufactures in silks, embroidery, and cottons, have long since excited the admiration of Europe; that its animal and vegetable productions, its metals, minerals, and valuable natural productions are scarcely yet known; and that science and the arts have yet to develope these internal resources, which will ere long raise its character? Is it extravagant to hope under British rule that it will become the greatest commercial nation in the world? The realization of these objects, however, depends materially upon the policy which the government of India may adopt in regard to its revenue. Whether it endangers manufactures and population, or whether with the constant extension of boundary it takes measures to improve the soil, realize millions of acres which are now covered with forest, brush-wood, and stagnant waters; whether it facilitates inland navigation, by deepening harbours, constructing docks, and encouraging ship-building,—the whole depends upon the adoption of a system of national policy, by which the advantages to the Government and the community may be reciprocal. It is during the times of peace that the great work of national improvement should go on, not as a matter of expediency, but of positive necessity. If we desire to erect the fabric of our rule and future prosperity on a permanent basis, while we are giving encouragement to trace out the unexplored gifts of nature and bring into action the hidden treasures of the land, we must concilitate public regard, by promoting the prosperity of the people. A specific sum might justly be appropriated to objects of national improvement, which, besides giving encouragement to ingenuity and merit, and employment to the industrious, would promote the circulation of the specie throughout the country; increase the demand for various articles of inland manufacture; and finally produce in their operation an annual equivalent equal to the whole amount of the original outlay, and most probably exceed it.

But we must hasten to a conclusion—we have only to state how far our views have been supported; this may be seen by the size of our publication and numerous plates which embellish it. It commenced with 32 pages and has progressively increased to 64, without additional cost to subscribers; and we trust, so soon as we experience a mitigation in the post office regulations, we shall be able to add numerous improvements, tending not only to increase the interest but the value of the work, on receiving additional support, which is essential to bring to perfection a periodical of the kind we have described.

No. 1. 1831. April

FOREIGN SCIENCE AND THE ARTS.

EMBRACING MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS. &c.

MINERALOGY.

15. PLAGIONITE.—The crystals of this mineral belong to the oblique rectangular prismatic system of Beudant. If we consider the faces belonging to an octahedron for the punvictur form, then the faces parallel to the plane of the two axes are truncatures of the anterior angles. They are implanted in quartz. Fracture conchoidal. G. Rose has termed it plagionite, from (πλαγιος oblique) in consequence of the oblique form and inclination of the axis, which measures 107° 32′. It consists, according to Rose of Lead 40.52 Antimony 37.94 Sulphur 21.53, Total 99.99.

Besides simple sulphuret of antimony, in the Wolfsberg antimonial veins, there are a great many combinations of sulphuret of antimony and sulphuret of lead in different proportions, viz: zinkenite, 3 Sb. su. + Pb. su. Plagionite, and Federerz, Bournonite. The two first have only been found at Wolfsberg. *(Poggendorff*, xxviii. 421.)

16. NATIVE LITHARGE has been found half way up the volcanoes of Popocatepetl and Iztacictualt in Mexico, corresponding exactly in appearance and composition with that derived from the lead furnaces, *(Ann. des. Mines*, vi.)

17. ARSENICAL PYRITES has been analyzed by E. Hoffmann from four localities:

	Schnee-berg.	Sladming.	Hartz.	Reichen-stein.
Sulphur ..	0.14	5.20	11.05	1.94
Copper ..	0.50	,,	,,	,,
Bismuth ..	2.19	,,	,,	,,
Arsenic ..	71.30	60.41	53.60	65.99
Nickel. ..	28.14	13.37	30.02	,,
Cobalt	,,	5.10	0.56	,,
Iron	,,	13.49	3.29	28.6
Serpentine	,,	,,	,,	2.17
	102·27	97.57	98.52	98.16

18. ARSENIC GLANCE.—Karsten found the composition of a specimen from Marienberg, in Saxony Arsenic 93.785 Bismuth 3.001 Total 99.786. *(Schweig. Seidel*, xxiii. 390.)

19. STERNBERGITE.—Zippa finds this composed of Silver 33.2 Iron 36.0 Sulphur 30.0, Total 99.2, equivalent to 4 F Su. + Ag. Su. *(Poggendorff, Ann.* xxvii.)

20. MELANOCHROITE.—This mineral is found in the neighbourhood of Beresow, in the Uralian Mountains, in limestone, where it is accompanied with vauquelinite, phosphate of lead, quartz, and galena; colour between cochineal and hyacinth; compact; crystals, rhomboidal prisms, with two large faces, which gives them a tabular appearance; edges, translucent; streak, brick-red; sp. gr. 5.75. Before the blowpipe fuses easily into a brown mass, which assumes a crystalline structure on cooling. In the reducing flame it is converted into oxide of chromium and metallic lead. It consists of Oxide of lead 76.36 Chromic acid 23.64, Total 100.00.

It is obviously, therefore a subsesqui-chromate of lead. *(Poggendorff*, xxviii.)

21. CHROME IRON ORE, from Baltimore, was found by Abich to contain, *(Poggendorff*, 1831.)

	Crystallized.	Amorphous.
Silica.....	—	00.83
Alumina	11.85	13.85
Oxide of chromium ..	60.04	51.91
Protoxide of iron.....	20.13	18.97
Magnesia	7.45	9.96
Total.......	99.47	98.52

22. WHITE ARSENIATE OF IRON.—Kersten found a specimen of this mineral from Freiberg, to consist of Arseniate of iron, 70.70, Water, 28.50, Total 99.20. *(Schweigger Seidel's Jahrbuch*, vi. 182.)

23. POLYBASITE.—H. Rose has analyzed this mineral from the following localities:—

	Guarisamny, Mexico.	Schemnitz.	Freiberg.
Sulphur....... ..	17.04	16.83	16.35
Antimony.......	5.09	0.25	8.39
Arsenic.........	3.74	6.23	1.17
Silver...........	64.29	72.43	69.99
Copper....... ...	9.93	3.04	4.11
Iron............	0.06	0.33	0.29
Zinc............	0.00	0.59	0.00
Total....	100.15	99.70	100.30

(Poggendorff, xxviii. 156.)

24. VOLTZITE.—This mineral is found at Pont Gibaud, in Puy de Dome. It possesses a pearly lustre; colour rose-red, or of yellow; granular; fracture irregular; softer than glass; sp. gr. 3.66. It consists of Sulphuret of zinc, 82.92, Oxide of zinc, 15.34, Peroxide of iron, 1.84, Total 100·10. *(Poggendorff*, xxxi.)

25. CARBONATE OF LEAD AND ZINC, comes from Mount Proxi, in Sardinia in the form of small crystals, irregularly grouped together in rock quartz; white and translucid; hardness equal to calcareous

spar ; sp. gr. 5.9. It contains Carbonate of lead, with traces of chloride of lead 92.10, Carbonate of zinc, 7.02, Total, 99 12. *(Jahrbuch, 3d,* 1833, p. 335.)

26. GAHNITE, according to the analysis of Abich, consists of Silica, 3.84, Alumina 55.14 Magnesia, 5.25, Peroxide of iron, 5.85, Oxide of zinc 30.02, Total 100.10.
The specimen was from Fahlun.

27. BLUE ARSENIATE OF COPPER, from Cornwall, consists, according to Trolle Wachtmeister, of Oxide of Copper, 35. 19, Alumina, 8.03, Peroxide of iron, 3.41, Arsenic acid, 20.70. Phosphoric acid, 3.61, Silica and quartz, 6.99, Water, 22.24, Total 100,26, *(Jahrbuch,* lst, 1833. p. 73.)

28. PLATINUM, in Siberia, is found in fine sand. A piece was obtained at Nischne Tagil, weighing 4 Kilogrammes (8 lbs. 13 oz. 4 dr. avoird.) in 1827, and three bits in 1831-32, the two first weighing 8 kil. (17 lbs 11 oz. and the third 5 kils. 11 lbs. 1 oz. 1 dr.) It is accompanied with gold, osmium, iridium, magnetic iron, chromium, brown oxide of iron, oxide of titanium, epidote garnet, rock crystal, and sometimes diamonds. The sand is composed of jasper, quartz, and greenstone, and likewise small yellow crystals of rhomboidal, dodecahedrons, resembling chrysoberyl, the nature of which is not known. Among the rocks which accompany platinum in the Uralians, serpentine is the most remarkable. Gold appears generally to exist in the same rock with platinum. *(Jour. de St. Petersburg,* 1833)

29. OSMIUM AND IRIDIUM.—Two minerals have been obtained in the Uralians, composed of these two metals. One found at Newiansk possesses a compound crystalline form, consisting of the combination of a double pyramid with six faces, with a right hexagonal prism. It possesses a blue metallic lustre. Hardness nearly that of quartz. Sp. gr. 19-386 — 19-471. Before the blowpipe, on charcoal, it does not decompose. In the matrass with saltpetre a feeble smell of osmium is observable. It is found in the auriferous sand of Newiansk, 95 versts to the north of Katharinenberg. It is also observed at Bilimbajewsk and Kyschtim, and several other places in the Urals. The crystals of the variety from Nischne Tagil have the same form as the preceding. The colour is bluish-gray, analogous to that of sulphuret of antimony. Hardness about that of quartz. Sp. gr. 21-118. Before the blowpipe, on charcoal, becomes black, and looses its lustre, and disengages a pungent smell of osmium, which acts upon the eyes. It is found in the platiniferous sand of Nischne Tagil. It is never associated with gold.

These two combinations of osmium and iridium, possessing the same shape, G. Rose considers that the idea of the isomorphism of the two metals is confirmed. The Nischne Tagil variety, which contains more osmium than that of Newiansk, having a higher specific gravity, it follows that osmium is heavier than iridium. Osmium ought then to have a higher specific gravity than 21-118. Hence, it is obvious that Berzelius' sp. gr. 10 is quite erroneous. *(Poggendorff Ann.* xxix, 452.)

30. NATIVE IRIDIUM has been found at Nischne Tagil, accompanied with gold and platinum. It is in grains of the colour of silver, verging towards yellow, possessing a strong metallic lustre, and is extremely hard. Sp. gr. 23-5 — 23-6. Insoluble in acids. It is combined with some osmium, and may be easily fused. *(Breithaupt in Schweigg Journ.* 1833.)

31. CHEMICAL COMPOSITION OF NATIVE GOLD, PARTICULARLY URALIAN GOLD.—Gold is never found in the earth in a pure state, but is always combined with more or less silver.

Fordyce examined a specimen from Konsberg, in Norway, which consisted of 28 gold, 72 silver in the 100 parts. Klaproth obtained gold from Schlangenberg in the Altai, 64 gold, 36 silver ; and Lampadius, from an unknown locality, procured 96-6 gold, the remainder being silver and iron. Boussingault analyzed gold from different places in Colombia, and found it combined with silver in variable quantities, but always in difinite proportions, viz.: one atom of silver with 2, 3, 4, 5, 6, 8, and 12 atoms gold. *(Ann. de Chimie,* xxiv. and xlv.) G. Rose, while travelling in Siberia with Baron Humboldt, made a collection of gold ores for the purpose of determining the truth of the French chemist's position.

In the Uralian Mountains, gold is found in rocks and distributed among sand. Previous to 1819, it was extracted from rock veins, but after this period, the discovery of sand containing it occasioned the abandonment of working the rock mines. Gold in rocks is found always in quartzose veins: at Beresow, occurring in the form of crystals, and at Newiansk, in plates, while at Czarewo Alexandrowsk, pieces are met with which weigh from 13 to 24 livres, (18 lbs. to 96 lbs. troy.) Gold produced by the different workings is assayed in the mints of Katharinenburg, and St. Petersburg.

The following table exhibits the composition of gold from different localities, all being richer than gold from Colombia and Siebenburg:—

		Gold.	Silver.
Katharinenburg ..	sand	93·01	6·99
Hiel............	rock	87·40	12·60
Miask...........	sand	93·0	7·00
Bogowslowsk......	—	88·80	11·20
Kuschwa	—	90·30	9·70
Werch Isetsk	—	92·70	7·30
Nischne Tagil......	—	90·73	9·27
Kaslinski	—	91·97	8·03
Newiansk....	—	91·42	8·58
Do............	rock	92·95	7·05
Sisersk,........	sand	91·78	8·22
Ufaley	—	91·45	8·55
Schaitansk.......	—	95·10	4·90
Bilimbajeusk..	—	93·54	6·46
Do....	—	91·24	8·76
Bewdinski....	—	93·33	6·67
Usewoledski.... ..	—	89·01	10·99
Bissersk..........	—	88·72	11·28

Before the blowpipe, pure gold and pure silver are readily distinguished by their fusing into a transparent and colourless glass, with salt of phosphorous in the exterior flame. In the interior flame, if the quantity of silver is small, the glass is opaline and yellowish, but if great, altogether yellow and opaque. The native alloys act in the same manner, but an alloy which contains only $\frac{1}{4}$ per ceut. of silver has no action on salt phosphorous.

When the quantity of silver is small, which can be easily detected by the golden colour of the alloy, the metals may be dissolved in a covered capsule, in aqua regia. The greatest portion is converted into chloride of silver. Decant the solution and remove the chloride by the aid of a glass rod, and add a new dose of acid. If the alloy contains more than 20 per cent of silver, the chloride sticks to the glass, and gives rise to inaccuracy. The two acid solutions should then be diluted. The first is only slightly muddy; for, it appears that a saturated solution of gold does not dissolve a notable quantity of chloride of silver; the second, on the contrary, deposits a considerable quantity of this substance. When the whole chloride has been deposited it should be filtered and weighed, after being dried and fused in a porcelain crucible. Evaporate the liquid in a porcelain crucible, to drive off the excess of chlorine, and when fumes cease to be given off, treat it with oxalic acid. Place the liquid in a glass defended by convex cover, in order that no gold may be mechanically removed with the carbonic acid, and allow the glass to remain for 24 hours in a warm place. Filter the liquid, evaporate to dryness, and pass a stream of sulphuretted hydrogen through the solution of the residue in muriatic acid. A trace of copper is thus separated, and the iron may be removed by hydro-sulphuret of ammonia.

When the gold contains more than 20 per cent. of silver, the correct plan is to assay the alloy in a cupel with lead and silver, and to treat the new alloy with nitric acid, which takes up the silver only. Gay Lussac shewed that a loss of silver is sustained to a small extent in this way, and G. Rose, to obviate the inadequacy of this plan, tried a number of others, and at last hit upon one which he considers better than any other yet devised. Fuse the native gold in a small porcelain crucible with lead, by means of a lamp supplied with a double current of air. Digest the mass in nitric acid; detach it from the crucible, and place it in a glass vessel, adding a new portion of nitric acid diluted with water, in order to dissolve the nitrate of lead; wash the residue; dissolve it in aqua regia; precipitate the chloride of silver dissolved, diluting the liquid with water; filter the liquor and evaporte to dryness. Dissolve in water, and precipitate the gold by means of muriate of iron. Sulphated protoxide of iron does not answer for the precipitation, because the gold in solution may still contain a little lead. Dilute the nitric acid solution with much water; then treat it with chloride of lead, and not with muriatic acid, which may drecipitate part of the lead in the state of chloride. Place the liquid in a warm place, to favour the precipitation of the chloride of silver, and when the solution has become clear collect the chloride upon the filter which was used to filter the solution of gold. The minute portion of iron cannot be appreciated, on account of the quantity of lead.

Rose has never found platinum and gold associated. He deduces from his analyses several important consequences.

1. Native gold does not contain gold and silver in definite proportions.

2. Gold and silver being thus combined in indefinite proportions, he concludes that they are isomorphous, an inference which cannot be deduced with the same certainty from the identity of their crystals.

3. Native gold always contains silver, copper, or iron. The smallest quantity of silver was in a specimen from Schabrouski, which contained 16 per cent. of silver, but 35 per cent. of copper were present.

4. The specific gravity is in the inverse ratio of the proportion of silver contained in the mineral.

In general, fused gold has a greater density than native gold, which, however, may be owing to cavities in the latter.

5. Different specimens from the same locality vary in composition.

6. Gold found in veins varries in different parts of the same mine.

7. He finds that the gold from sand contains more silver than that from veins. The proportion in the former being 89-7 per cent. of silver, and in the latter, 79-1 a fact completely contrary to the determination of the Russian government, for the mining of gold has entirely yielded to the process of procuring it from sand. *(Poggendorff Ann.)*

STATE OF THE GLOBE AT ITS FORMATION.

BY M. BECQUEREL.

(Continued from page 153.)

TERRESTRIAL HEAT.—The facts with which we are at present acquainted tend to prove that every place on the surface of the globe has an invariable mean temperature. The mean temperature of the equator is between 81.5 and 82°4, being modified by the great extent of the equatorial seas. The entrepid northern navigators have found a great difference, in the same latitude, between the temperatures on land and in the open sea. A Melville Id. the mean heat was—18°5C., while in the open sea it was—8° 3. Calculating from these data, the temperature of the pole would be—25° or 30°.

It is remakable that those places which are situated on the same isothermal line do not present the same vegetable productions. Hence, some have divided climate into constant, where the temperature is steady during the year, variable, and excessive, which comprehend those where the differences are very great. Cassini, in 1671, had remarked that under the Observatory of Paris, the temperature was steady during the whole year

and the observation has been confirmed, the heat being determined to be 11° 82 (53° F.) Cordier has inferred from his researches on the temperature towards the interior of the earth, that below a particular point where the temperature is steady, the heat increases with the depth, to the amount of 1° for every 25 to 30 metres.

M. Fourier has demonstrated that the cooling of the globe, *if such a fact is admitted*, must be very slow, being less than $\frac{1}{51600}$ of a centigrade degree for a century; and he has drawn these consequences: 1. All the heat below a particular point where the temperature is steady, has been possessed by the earth from its commencement. 2. This heat is intense in the nucleus, and at a certain distance from the centre it begins to diminish by regular laws up to the steady point. 3. The internal equilibrium changes with time, and will continue to alter until the whole heat is dissipated, but this process is going on in an extremely tardy manner. 4. The heat derived from the interior cannot appreciably modify that of the surface.

Humboldt has observed that in Mexico the decrease of temperature is not proportional to the height; and Boussingault has found that in twenty-three years the sources of the Mariara have increased in temperature from 59° 3 C. to 64°; and those of Strincheras, from 9° 4 to 92° 2. The diurnal variation of the thermometer at the equator on the sea is 1° to 2°, while on the continent it is 5° to 6°. At the equator the ocean's surface is hotter than the air; but at the poles the reverse is the case.* Between the tropics, the heat diminishes with the depth; on the polar seas it diminishes as we descend.

Such are some of the principal circumstances bearing upon terrestrial heat with which we are at present acquainted.

THE FORMATIONS OF WHICH THE GLOBE IS COMPOSED is the next subject which our author takes up, after speculating upon the method in which it was consolidated, applying known agents to the explanation of volcanic phenomena, and tracing out a sketch of the facts which have been ascertained in reference to terrestrial heat. He first notices alluvial deposits which are in process of formation, consisting of peat, marls, graval, stalactities, pisolites, and travertines. He then passes to mineral waters or salt springs, which are so influential in bringing up from considerable depths soluble salts. In these are found carbonate of soda, borax, alum, deposited in the fissures of rocks, nitrate of soda as in Peru, nitrates of potash, lime and magnesia, as in Hungary, Ukraine, Podolia, &c.; sulphate of magnesia, sulphate and carbonate of lime. These substances seem to be deposited by the water when traversing fissures of rocks, and which action is more energetic in proportion to the increase of temperature. The quantity of salts brought by these means is much greater than one without consideration would infer. The Carlsbad water discharges annually 746,884 pounds of carbonate of soda, and 132,923 pounds of sulphate of soda, in addition to numerous other substances. Now, the operation of solution must be effected by the electro-chemical action of the thermal waters upon the rocks, at a greater or less distance from the earth's surface.

The origin of the ocean's saltness has attracted the attention of many, but little light has been hitherto thrown on this subject. It is, however, apparent, that the quantity of saline matter varies on account of the proximity of rivers; thus, the Baltic and the Black Sea are weaker than the ocean, and still more so than the Mediterranean.

From Boussingault's observations, it appears that the temperature of hot springs diminishes with the height; and hence he infers that they have their origin in the volcanic fires. He found that the mineral waters near volcanoes contained sulphuretted hydrogen and carbonic acid, the identical gases which were detected among the vapours emitted from their corresponding volcanoes. The carbonic acid he considers as the product of the calcination of carbonate of lime and soda, or of their reaction upon silicious or aluminous substances, and the sulphuretted hydrogen may derive its origin from the re-action of the vapour of water upon sulphuret of sodium.

The rocks of the tertiary formations are in general calcareous and silicious with a predominance of magnesia, especially where the gypsum appears. Under this head are included the new formations characterized so happily by Mr. Lyell, and to whose work it is proper to refer the reader for accurate and interesting information.

The secondary rocks include the chalk, which is the result of chemical precipitation, the oolites, a sedimentary group, as well as the muschelkalk and zechstein.

In the transition rocks, the coal, according to Deluc, has been formed at a slight elevation above the sea like turf, and has been submerged and covered by the sand of the ocean. If these waters are supposed to have borne along with them earthy matter of an elevated temperature, an explanation will be afforded for the absence of animals in these rocks. The water under which the coal was formed must have possessed the property of holding iron in solution, as is apparent from the quantity of iron-stone which usually accompanies coal. Hence, the atmospheric pressure may have been greater.

The formations which derive their origin from the greatest depths, are obviously granite, mica slate, and the rocks usually termed primary. The porphyries, euphotides, or compounds of jade and diallage, serpentines, black porphyry, or ophites and dolomitess, are more variable in their position.

Among volcanic products the trachites are considered most ancient, and are sometimes startified. The traps, or basalts afford many minerals; the lava group contain also many species. Both Ætna and Vesuvius have been known to eject granite, in addition to the pulverulent and solid matter which they continue to emit at intervals.

* In lat. 2° 9′ N., long. 20° 38 W., I found the temperature of the Atlantic Ocean 79°5, that of the air being 79°; and in 2·20 S. L., 59°5′ E. L. the thermometer stood in the air at 80°, and in the Indian Ocean at 88°6.—EDIT.

DECOMPOSITION OF ROCKS—VEINS.—According to Becqueiel, veins are not to be considered as products of one general cause, but of a concurrence of several causes. The viens in the most ancient rocks are smaller than in the newer rocks, the largest existing in the schists and transition limestones. Werner considered that rocks were decomposed by two acids: I. By carbonic acid as when granite and gneiss or felspar alone are decomposed and form kaolin. 2. Sulphuric acid derived from pyrites, as in veins of felsp r, mica, and amphibole. Arsenic acid he considered produced a similar effect.

M. Fournet, who has paid much attention to veins, distinguishes two kinds: those of igneous origin, such as porphyries, trachites, &c. in which the silica has formed combinations by means of heat; and those of aqueous origin, as we see illustrated in mineral waters. To exemplify the former he cites those instances where sulphuret of iron, silica, and iron pyrites have been deposited upon the fragments of primitive rocks, and with regard to the latter, he mentions cases where talc and mica are changed into a grey substance, and granites where felspar is altered into kaolin, likewise talcose schists where steatite is isolated in veins. In the veins of Pont Gibaud, he observed four other epochs. At the second period new branches were formed, which were filled with secondary and tertiary products, especially quartz, but likewise sulphurates, which have formed alternating zones of pyrites, galena, and hyalines quartz in small crystals. A third period distinguishes a dilatation which disturbed the sources of the galena and introduced solutions of sulphates of barytes. At the fourth epoch, the incrusting power of these sources appears to have been enfeebled, when parites and minute veins of carbonates were deposited. The fifth epoch was contemporaneous with the basaltic eruptions. It is obvious, that for an explanation of the mode in which these veins are filled, we must have recourse to chemistry. Thus, hydrate of iron proceeds from the decomposition of pyrites; the powder of hydrous oxide is derived from the decomposition of the carbonate, ga ena is gradually converted into a black pulverulent substance, which gives birth to black and white carbonate. With regard to the formation of rock-salt, Dumas has observed that in one variety of it which decrepitated when placed in water, the cause was attributable to hydrogen which condensed in its cavaties.

GRANITE.—Saussure attributed the decomposition of this rock to a corrosive juice which dissolved the gluten uniting all its parts. Vanquelin and Alluan traced the cause to disintegration of the rock, and the removal of the alkali in the felspar by water. But Berthier has shewn that silica as well as potash is removed, a silicate of potash disappearing and silicate of alumina remaining. Felspar is probably one of those bodies whose particles are placed in such intimate union that acids have no effect upon it until it be exposed to electro-chemical agency. Fournet has observed three preliminary stages in the decomposition of granite. 1. A superior zone of a red or yellow colour, indicating the peroxidation of iron. 2. A middle zone of a deep green colour. 3. An inferior zone, presenting all the characters of a perfect granite, but falling to pieces when touched. He accounts for the successive decomposition from the surface, internally to dimorphism, which has changed their crystalline texture like arragonites and laumonites. Gustav. Rose has produced pyroxene and amphibole as instances of this dimorphism, of which some result from rapid, others from slow cooling. The theory of the felspar decomposition Fournet sums up shortly. The iron is peroxidized, carbonic acid is absorbed and takes the place of the silica, which, being set at liberty in a gelatinous state, dissolves in water, or alkaline carbonates, and gives origin to crystals of hyaline quartz, iorites, agates, opal, calcedony, and silicates, as chabasite, mesotype.

This theory, however, rests upon two suppositions which have not yet been demonstrated. 1. That igneous rocks do not acquire a state of permanent equilibrium, and that they exhibit in the course of time an effect of dimorphism, and 2. That carbonic acid is absorbed by these rocks. The latter appears to be strongly exhibited in Auvergne, where numerous mineral springs, which escape from granite fissures, act upon the rocks, and form small irregular basons which they fill with hydrous peroxide of iron.

SPARRY IRON ORE.—Granite before it decomposes disintegrates, but the iron ore retains its form, and yet changes its chemical nature. Becquerel has examined the process of the decomposition of this mineral in Isere, and he has found it entire when preserved from the contact of air and water. In Dauphine it is decomposed in such a manner as to give out heat and light, which burst into flame and continue to burn. The inhabitants regard the presence of these flames as a decided proof of the existence of rich mines of this mineral. The mineral contains carbonate of manganese and magnesia. The iron and manganese change into hydrates, lose their carbonic acid which combines with the magnesia, and renders it soluble in water. Water is decomposed to afford oxygen to the hydrate, and the hydrogen inflames after overcoming an immense pressure.

According to Chapert, when some of the minerals accompanying this iron ore are roasted, and left to spontaneous action, after some days, sulphate of magnesia and iron, and carbonate of copper appear, facts of great importance in electro-chemistry. Four kinds of pyrites accompany this ore, which give origin, to 1. Neutral sulphate of iron. 2. Earthy sulphate, a yellow substance, resinous or earthy. 3. Ochre proceeding from the action of air upon the neutral sulphate; besides, sulphate of iron and alumina, manganese, line, zinc, &c.

LAVAS.—Granite decomposes readily in contact with bay-salt, as is evinced in Scotland and Clermont. The facility of the decomposition of lavas varies with their composition; thus the pyroxenic rocks of Auvergne decay more rapidly than the Labra-

dore masses of Como. Wacké is a rock formed by the action of water upon these rocks, and contains calcareous spar, zeolites and piperine.

There is reason to think that the crystals which are found in bay-salts, have been deposited after the consolidation of the rocks in which they are found, because most of them are altered by a strong heat, and lose their water of crystalization. Fournet attributes the formation of zeolites to the transportation of the elements by water from the neighbouring rocks.

ORGANIC MATTER.—The mode in which organic matter undergoes decomposition has not been much studied, but a few curious facts have been ascertained. Davy found the manucripts of Herculaneum converted into a kind of turf, the leaves being united into a single mass by a peculiar substance, formed by the chemical changes of the vegetable matter. The *guano* in Peru is found in deposites of 50 or 60 feet deep, and is formed of the excrement of herons which inhabit the coast.

Necker de Saussure has observed the teeth of the *ursus spilæus* in the mines of Carmiola, corroded as if by an acid. Turpin has noticed the egg of the garden snail to be covered on the interior surface of its envelope, with rhombohedral crystals of carbonate of lime. The cellular tissue of the cactus, and the medullary tisue of palms contain oxalate of lime in crystals.

NITRIFICATION.—When distilled water is placed over plates of iron, lead, zinc, or tin, ammonia is formed in consequence of the combination of the hydrogen of the water with the azote of the air.

Vasquelin found ammonia in some rusty spots on a sabre, which had been employed by an assassin, and that other traces presented the same substance. Protoxide of iron, zenite, earthy oxide of iron heated in a tube, give out ammonia was detected in the ferruginous water of Passy after evaporation. Boussingault has observed it likewise in oxidized iron by taking a fragment of it, treating it with dilute muriatic acid, evaporating the washings, and heating the residue with quicklime in a tube, using the precaution to moisten them with water. Faraday obtained ammonia, by heating zinc foil in a glass tube with potash. The experiment succeeded even in hydrogen gas. Potassium, iron, tin, lead, and arsenic likewise afford much of it, with soda, lime, barytes or potash. The alkalines alone do not yield it.

The formation of saltpetre has long been a subject of interest. Dumas conceives that the presence of organic matter is not essential. Claubry attributes its production to the action of an acid moisture upon carbonate of lime.

Fournet thinks that nitric acid may be formed without the presence of organic matter, by the re-action alone of the elements of air and vapour of water. For according to Saussure, oxygen is more condensable by porous bodies than azote, in the proportion of 6′5 to 4′00; and Gay Lussac and Humboldt have observed that air disengaged from water by boiling, contains more oxygen in proportion to the slowness of its extrication. The result is that oxygen is not only retained with a greater power, but the composition of the last portions of the air approaches pretoxide of azote. Fournet has concluded, that the united action of porous bodies and of water upon the elements of air, would produce at first, protoxide of azote; then nitrate of ammonia, which when decomposed, resolves itself into protoxide of azote and vapour of water. The nitrate acts upon the alkaline carbonates and forms nitrate of potash, while the ammonia is disengaged in union with carbonic acid. He applies his theory to explain the production of nitrate of ammonia, dissolved in rain by the electric agency. He concludes by observing, that in every electric chemical action, however feeble it may be, if water is decomposed in contact with air, ammonia is formed.

LAST GEOLOGICAL REVOLUTION.—Becquerel endeavours to calculate this period, by a method which it must be allowed is extremely vague. He finds that the cathedral of Limoges, which has stood for four centuries, and is built of granite, is decomposed on that side where the winds and the rain beat to the depth of $3\frac{1}{2}$ lines, and that the rock in situ is disintegrated to the depth of 5 feet or 720 lines. If both have progressed at the same rate, he conceives that the rock in its natural place must have been decomposing for above 82,000 years.

TERRESTRIAL MAGNETISM.—From the facts which have been brought forward by Humboldt and others, it appears proper, that experiments should be made upon the magnetism of the rocks, which constitute the formations of the country in which the experimenter is placed, or at least to determine at what point the extent of oscillations diminishes without changing their number.

ATMOSPHERIC ELECTRICITY.—Saussure has shewn that in summer the electricity of the calm air is much weaker than in winter; and that the apparent force of electricity, depends not so much on the absolute height of the place of observation as upon the relative height, or on the insulation of the place. Disseminated as this principle is through the medium of the vapour of water, it is highly probable that it exercises no inconsiderable effect on the plants and animals which are of necessity subjected to its influence.

Becquerel terminates the first volume of his work, with some remarks upon the agencies by which the decomposition of some rocks and the formation of some insoluble compounds may be explained, which comprehends a recapitulation of some points. But he shews more particularly, how electro-chemical action operates in producing many minerals. Phosphate of iron in mines and crevices he considers to be the result of the action of electricity, which is disengaged during the peroxidation of iron and the decomposition of organic matter. The formation of the chromate of lead as it exists native, may be imitated by treating a solution of nitrate of lead with chalk and then with chromate of potash. In the course of a month or two, crystals of

chromate of lead were observed on the surface of the chalk. By mixing sub-nitrate of copper, with arseniate of copper, a double arseniate of copper and ammonia, and of arseniate lime and ammonia is formed The re-action of bi-carbonate of soda upon gypsum gives origin to carbonate of lime which crystallizes, sulphate of soda remainingin solution.

A supplementary chapter is appended, containing a short outline of the interesting electro-chemical researches of Dr. Faraday.

ON RESPIRATION.

BY THOMAS THOMSON. M. D., F. R. S., L. AND E., &c.

Regius Professor of Chemistry in the University of Glasgow.

When the experiments on respiration were made by Lavoisier, Goodwin, Menzies, Davy, &c., towards the end of the last century, it seems to have been the generally received opinion, that every individual by inspiring the air into his lungs, produces the very same change upon it. At least, the conclusions respecting respiration to be met with in Physiological and Chemical books, depend for their accuracy, upon this assumption. Nothing, however, can be farther from the truth. The chemical changes produced in air by respiration, vary in their extent, not only in different individuals, but even in the same individual at different times; and that to such an extent, that if we analyze air thrown out of the lungs at different times, we find the quantity of carbonic acid, sometimes not to exceed two per cent, and at other times to amount to more than seven per cent. Dr. A. Fyfe and Dr. Prout have shown many years ago, that an alteration is produced in the quantity of carbonic acid in the air expired, by the mode of living of the individual: that when the constitution is affected by mercury, the proportion of that gas in the air expired is diminished and that it is diminished also by nitric acid, by spirits, and by a vegetable diet. But I have found that the most unexpected alterations are observable in the same individual, though he be in perfect health, and though he make no sensible alteration in his mode of living.

During the course of the month of May, 1832, I analyzed air from my own lungs on ten consecutive days, between eleven and twelve o'clock each day. Before stating the results, it may be proper to mention the method of analysis employed. I procured a glass tube, capable of holding about three cubic inches of air, and about half an inch in diameter. It was shut at one end and open at the other. This tube being filled with mercury, and placed inverted on a mercurial trough, I introduced into it about two and a-half cubic inches of air from my lungs, taking care, in the first place, by making half an expiration through a narrow glass tube, to expel all the common air from the trachea and mouth, and also from the tube, by which it was conveyed to the eudiometer. The surface of the mercury in the tube was then marked by tying round in a sewing thread, and the whole was left till the air ceased to contract. Then a quantity of moderately strong potash ley was introduced. and the whole was left untouched for twenty-four hours. The diminution of bulk of the air was then carefully marked, by tying a sewing thread round the tube at the new surface of the mercury. I then filled the tube with mercury, up to each of the places marked by the sewing threads, and weighed each portion of mercury. The difference between the two weights, gave the diminution of bulk sustained by the air, by the absorption of its carbonic acid. I then calculated, what the bulk of the air and of the carbonic acid gas absorbed would have been, at the mean pressure and temperature; making allowance for any change in the height of the barometer and thermometer, which took place during the interval. I ought to observe, however, that during the ten days of these experiments, both the barometer and the thermometer were tolerably steady.

The following table exhibits the volume of carbonic acid gas, in 100 parts of the air expired from my lungs during each of the ten days, at 11 o'clock A. M. :—

	Carbonic acid.		Carbonic acid.
1 ..	4·64 per cent.	6 ..	2·05 per cent.
2 ..	4·70 „	7 ..	2·39 „
3 ..	6·07 „	8 ..	3·85 „
4 ..	3·27 „	9 ..	3.05 „
5 ..	5·26 „	10 ..	7.16 „

I was not a little surprised at these results: the differences being so much greater than I had anticipated. The mean of the whole is 4·24 per cent., which, therefore, I am disposed to consider as representing the mean quantity of carbonic acid gas, contained in 100 volumes of air expired from my lungs.

I was naturally induced to examine the air from the lungs of several other persons, in order to see whether there would be the same difference in theirs as I had observed with respect to myself. The gentlemen whose breathing was examined, were chiefly those who were occupied with practical chemistry in my laboratory. The following table exhibits the results obtained:—

CARBONIC ACID.

Mr. Thomas Thomson, (aged 14) 3-06 per cent. Ditto, next day, 3.61, Mr. J. Calquhoun (aged 18) 3.09 Mr. Farrest (aged 18) 2.10 ditto next day 5.19 Mr. Coverdale 2-54 ditto, next day, 1-71 Mr. Cargill, 4-68 Mr. Bruce, 5-46 Dr. Duncan, 6.17 Dr. Short, 6-85 Mr. Frazer, 7-08.

I prevailed upon two ladies to allow me to examine the air from their lungs. The first was an unmarried lady about seventeen years of age; the second a married lady, aged about 30. The results were as follows:—

First lady .. 2-35 | Second lady .. 4-06

The diversity here is fully as great as in my own case, but the mean of the whole does not differ much from that of my own. I am disposed, therefore, to infer from these trials, that the average volume of carbonic acid gas, in 100 volumes of air, expired from the lungs at 11 o'clock A. M. is 4-24.

But, from Dr. Prout's experiments, (Annals of Philosophy, II., 328; and IV., 331,) it appears that the quantity of carbonic acid gas produced by respiration, is at its maximum at noon, and that its quantity at 11 A.M. is to the mean quantity for 24 hours, as 3·92 to 3·45. It is obvious, from this, that the mean volume of carbonic acid gas in 100 volumes of air expired, deduced from the preceding experiments, is 3·72.

I made a few trials to to ascertain how much air different individuals are capable of forcing out of their lungs after a full inspiration. The quantity as might be expected, varies much in different individuals. But when the same individual repeated the trial, the result was very constantly the same. The following table shows the results.—

Mr. T. Thomson, 150, cubic inches. Mr. G. Thomson, 163, Dr. Duncan, 180, Dr. Thomson 193, Mr. J Colquhoun 200, Mr. Coverdale 200, Mr. Bruce 200, Mr. Forrest, 200, Mr. Frazer, 200, Dr. Short, 210, Mr. Cargill 250, 200 cubic inches is the most common quantity; but in one case it amounted to as much as 250.

The number of respirations in a minute does not vary much in different individuals, being very nearly twenty, or rather between nineteen and twenty.

I believe that great errors have been committed in the attempts to determine the quantity of air thrown out of the lungs by a common expiration. I am satisfied that the quantity which I pitched upon from the experiments of Menzies, Lavoisier, &c., namely, forty cubic inches is far too high. I find, after a great many trials, (for it is very difficult to make a natural expiration when your attention is called to it,) that the quantity of air which I myself throw out at a natural expiration, is sixteen cubic inches. My nephew, Dr. Andrew Steel, who was a tall man, (about six feet,) with an expanded chest, also made many trials, and satisfied himself that his ordinary expiration was sixteen cubic inches. Messrs. Allen and Pepys determined the volume of air expired by them at an ordinary expiration, to be sixteen and a half cubic inches. From these facts, I think we are entitled to conclude that a common expiration does not much exceed sixteen cubic inches.

If these data be correct, and they cannot be very far from the truth, it will be very easy to calculate the quantity of carbon thrown out of the body daily by respiration. Allowing 20 respirations per minute, and 16 cubic inches of air taken in and thrown out at each respiration, we have 28,800 respirations in 24 hours, and 460,800 cubic inches of air passing through the lungs. Of this $\frac{372}{100}$ or 17141·76 cubic inches are converted into carbonic acid gas. Now 100 cubic inches of carbonic acid weigh very nearly 50 grains: so that the weight of carbonic acid formed is 8,570.8 grains, $\frac{3}{11}$ths of which, or 2337.5 grains are carbon. This amounts to nearly nine ounces avoirdupois, or somewhat more than half a pound.—*Record of Science*, 1835.

ON THE CHANGES PRODUCED IN THE COMPOSITION OF THE BLOOD BY REPEATED BLEEDINGS.

By Thomas Andrews, Esq.

The object of the following experiments is to determine with precision, the changes which are produced in the composition of the blood by repeated abstractions of large quantities of it from the general circulation. In the human subject, opportunities seldom occur of procuring proper specimens for examination, although the operation of venesection is so frequently performed, as in those cases where it requires to be repeated at short intervals the blood is generally in a morbid state. Instead of waiting for such casual occasions, I directed my attention to those animals in which the composition of the blood is nearly the same as in man, conceiving that similar results would in either case be produced. I selected the blood of calves for the purpose of experiment, and as it is the practice of butchers in this country to bleed these animals several times before they are slaughtered, I availed myself of this circumstance to, procure suitable portions of blood. The animal is bled from a large orifice in the jugular vein, till symptoms of syncope appear, and the operation is in general repeated at intervals of twenty four hours It is once fed between each operation upon a mixture of meal and water, but this is often omitted before the last bleeding.

The appearance of the blood becomes greatly altered by the successive abstractions; the crasamentum is at first very large, and a portion of the red globules are unattached to it, but it progressively diminishes in bulk while its consistency increases, till upon the fourth bleeding it appears a small contracted ball immersed in a large quantity of serum, adhering to the stopper of the vessel in which it is contained, and presenting on its external surface an exact cast of the interior of the vessel.

The following analyses were performed by the same method that I formerly employed in a set of experiments on the blood of cholera patients, which were published in the Philosophical Magazine for September, 1832. They are nearly all a mean of two separate analyses which seldom differed from each other more than 0·5 per cent.

A calf was bled four times; between the first and second bleedings a week elapsed, but the rest took place at intervals of twenty-four hours, and the animal was fed between each operation. The composition of the serum and blood at each bleeding is exhibited in the following tables:

SERUM.

	FIRST.	SECOND.	THIRD.	FOURTH
Water	92·19	93·96	93·81	94.18
Albumen and Salts	7.82	6.04	6.19	5.82
	100.00	100.00	100.00	100.00

BLOOD.

	FIRST.	SECOND.	THIRD.	FORTH.
Water..	81.36	85.49	87.41	89.25
Albumen and Salts	6.89	5.50	5.77	5.52
Red globules &.. fibrin....	11.75	9.01	6.82	5.2
	100.00	100.00	100.00	100.00

The serum had at the third bleeding, a specific gravity of 1.020, and at the fourth, of 1.017. At the third bleeding, the specific gravity of the blood itself was 1.031.

The next calf whose blood was examined, was nine weeks old. I did not procure any blood from the first bleeding. The third bleeding was twenty-four hours after the second, and during that period, the animal was once fed; twelve hours afterwards it was bled a fourth time, but it received no more food:

SERUM.

	SECOND.	THIRD.	FOURTH.
Water	93.32	94.39	94.50
Albumen and Salts	6.68	5.61	5.41
	100.00	100.00	100.00

BLOOD.

	SECOND.	THIRD.	FOURTH
Water.....	82.05	89.14	88.92
Albumen and Salts	5.85	5.29	5.06
Red Globules and Fibrin	12.10	5.57	6.04
	100.00	100.00	100. 0

The albumen and salts it is evident, decrease at each bleeding; the diminution is, however, very variable, and even after the fourth time does not amount to one per cent. and a half. In the globules, the same diminution takes place but to such a degree that they are at least reduced to less than one half their original quantity. To this principle, a remarkable exception occurs in the composition of the blood taken at the last bleeding of the second calf, where the globules are slightly increased above the preceding analysis; but it will be observed, that the animal received no food during the intervening period, from which the blood might obtain a fresh supply of serum, while the tendency of the different excretions of the animal was to drain from the circulating mass its aqueous part, and thus to increase the apparent quantity of the globules. This explanation is confirmed by the following analysis.

A calf three weeks old was bled twice before it was killed, twelve hours elapsed between the two bleedings, during which time it obtained no food:—

SERUM.

	FIRST.	SECOND.
Water..............	92.48	93.35
Albumen and Salts...	7.52	6.65
	100.00	100.00

BLOOD.

	FIRST.	SECOND.
Water..............	82.48	83.47
Albumen and Salts...	6.70	5.95
Globules............	10.82	10.58
	100.00	100.00

The globules have here it is true diminished at the second bleeding, but so slightly, that we may attribute this circumstance to the unassimilated chyle which must have been present in the system. In the former case the animal had been exhausted by previous depletions, and hence possesed no store from which the blood could derive even a small portion of serum, as in the latter instance,

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RESEARCHES ON THE BLOOD.

BY L. GMELIN AND F. TIEDEMANN, ASSISTED BY E. MITSCHERLICH.

Poggendorff's Annalen xxxi.

Observers have differed with regard to the presence of carbonic acid in the blood.

Vogel found that under the receiver of an air pump, lime water was acted on by the disengaged carbonic acid.

Scudamore obtained in the same way, by means of barytes water, a precipitate of carbonate of barytes, equivalent to $\frac{1}{3}$ or $\frac{1}{2}$ cubic inch of carbonic acid gas, from six ounces of blood.

Brande procured from one ounce of arterial or veinous blood 2 cubic inches of carbonic acid.

On the other hand, Darwin could detect no such acid, and Dr. Davy asserts that it is neither extracted during the spontaneous coagulation of the blood, nor by the air pump, nor by coagulating the serum by heat, and that serum absorbs carbonic acid in greater quantity than pure water, which would not be the case if it was charged with carbonic accid.

Gmelin and Tiedemann examine with great care the blood of a dog taken from the femoral-vein and artery, and placed in different tubes under the receiver of an air pump. The result was that neither carbonic acid nor any other permanent gas was extricated. To ascertain the accuracy of Davy's statement with respect to the absorbing power of blood being greater than that of water, carbonic acid was allowed to stand over arterial blood for 5 days, when it was ascertained that 100 measures of blood absorb 120 of carbonic acid. The coagulum appeared blackish red, and the liquid portion was extremely clear.

Since blood contains no free carbonic acid, it was necessary to ascertain whether any existed in it in a combined state. Vinegar was added to each of the kinds of blood which had been collected, as in the former experiments, with every precaution to ensure accuracy, and was placed under a receiver. A quantity of carbonic acid escaped from both, more abundantly from the veinous than the

arterial. The arterial blood mixed with vinegar, as well as the veinous blood, left over mercury for 3 weeks, was converted into a blackish brown mass without being separated into serum and coagulum. About the same period, without a knowledge of the Heidelberg experiments, Ed. Ch. F. Stromeyer obtained the same results.*

How do these facts agree with the present theories of respiration ?

Lavoisier conceived that without coming in contact with the respired air, a liquid consisting principally of carbon and hydrogen is absorbed through the pulmonary membranes into the bronchi, and is converted into carbonic acid and water through the oxygen of the inspired air. As this theory does not render it necessary to suppose free carbonic acid in the blood, it is not at variance with the observations of Gmelin and Tiedemann, but the passage of gases into moist animal membrane, and also the immediate contact between air and blood cannot be well doubted of. Davy inferred from his results that air passes through the moist coats of the pulmonary vessels, and is taken up by the serum, the oxygen partly forming with the carbon of the cruor carbonic acid, and partly combining with the cruor. When he found that after the inspiration of hydrogen some carbonic acid was expired, though much smaller in quantity than after the inspiration of air, he concluded that veinous blood contains some free carbonic acid. According to the observations already given, it appears that the arterial and veinous blood contain no free acid but carbonic acid combined with alkali. And if we suppose acetic acid to be formed in respiration, (for we find it in the blood and in most organic liquids which are exposed to the influence of air in combination with alkalies), then must the veinous blood contain more alkaline carbonate than the arterial, when by the formation of acetic acid a portion of the alkaline carbonates will be converted into acetates.

By means of a barytes solution in an exhausted receiver, they estimated that 10,000 parts of arterial blood contain 8.3 of combined carbonic acid, and 10,000 parts of veinous blood 12·3 of acid in the same state, being in the proportion of 2 to 3.

They sum up their views of respiration in a few propositions :—

1. That in the pulmonary cells inspired air is absorbed into the moist membranous vessels, and is thus brought in contact with the blood.

2. The azote of the air is not sensibly absorbed by blood, but almost the whole of it remains in the cells. On the contrary, as oxygen is taken up by the blood abundantly, it flows out of the cells into the vessels in proportion to its absorption, and the mixture of gas remaining in the lungs must therefore contain more azote and less oxygen than the air.

3. The oxygen taken up by the blood combines partly with carbon and hydrogen, and forms carbonic acid and water, and partly unites with the solid organic compounds contained in the blood. From these proceed acetic or lactic acid, which combines with a portion of carbonate of soda contained in the blood, and drives its carbonic acid into the cells.

4. The acetate of soda loses in its course through the different secreting organs its acetic acid, combines again with carbonic acid after undergoing many decompositions in its passage with the mass of blood through the body, and enters into the lungs on its return as carbonate of soda.

* Schweigg. Journ. four Chem. lxiv. 105.

† Memories de l'acad des Sc, An. 1790, inserted in Scherer' Journal der Chemie x. 560.

TIEDEMANN'S PHYSIOLOGY, TRANSLATED BY GULLY AND LANE.

PARALLEL BETWEEN THE MATERIAL COMPOSITION OF ORGANIC BODIES AND THAT OF INORGANIC BODIES.

On the Chemical Mixture of Substances.

V. All organic and almost all inorganic bodies are composed of simple materials, diversely combined with each other, and which may be separated by chemical operations. However, when we compare the composition of these two groups of bodies, we recognise important differences between them. Thus the first are for the most part assemblages of particular combinations, which we first meet with when we chemically analyse plants and animals. There are, in the vegetable kingdom, starch, vegetable albumen, gluten, gum, sugar, &c. ; in the animal kingdom, animal albumen, fibrin, gelatin, mucus, &c. These matters are called by chemists the immediate or proper matters of organized bodies, or the simple organic compounds.*

VI. In submitting anew the immediate principles of organic bodies to chemical analysis we obtain the mediate principles, or the simple matters, which chemistry has not yet further decomposed, and which for this reason are denominated elements. The ponderable mediate principles of organic bodies are :

A. Non-metallic substances ; namely, 1 oxygen, 2 hydrogen, 3 carbon, 4 nitrogen, 5 phosphorus, 6 sulphur, 7 iodine, 8 bromine, 9 chlorine, and 10 fluorine.

B. Metallic substances :

a. Alkaline metals—11 potassium, 12 sodium, and 13 calcuim.

b. Earthy metals—14 magnesium, 15 silicium, and 16 aluminum.

c. Ponderous metals—17 iron, 18 manganese, and 19 copper.

Among imponderable substances those which can in some circumstances be recognised in organic bodies, are light, heat, and electricity.

* The French chemists call them " *les principes immediats organiques.*" We may give them the name of organic matter or those adapted to life, because they are essential constituent parts of living beings and the phenomena of life are perceived only in bodies that are composed of such.

All these elements are likewise found in inorganic bodies. Organic bodies, therefore, do not differ from the latter in regard to elementary matters. But great differences exist relative to the number of elements which enter into organic combinations, and in the manner in which they are joined together.

VII. The number of elements which enter into the composition of bodies included in the organic kingdom, is much less considerable than that of the elements which exist in the other kingdom. Organic bodies, as far as we can judge of them from the data hitherto collected by chemistry do not present, putting aside the imponderable matters, more than the nineteen elements which I have enumerated,* while fifty-two have already been found in the other kingdom. All the substances which chemistry regards as simple, do not therefore enter into the composition of organic bodies, which, on the contrary, only contain the smallest proportion of them. From among the substances therein discovered, those which exist in greatest quantity are oxygen, hydrogen, carbon, and nitrogen in infinitely varying proportions. The rest are by no means abundant in comparison with these.

VIII. Although the number of elements in organic bodies in general be small, nevertheless the composition of a living body, a plant, or animal, is much more complicated than that of an inorganic body. Besides the fact that almost always one and the same vegetable or animal presents at the same time, in its different parts, very diverse modes of combination, we observe that all the compound or organic matters proceed from three, four, or more elements. There are three elements at least in them, united together in an immediate manner, without having a preliminary binary combination. Vegetable mucus, sugar and starch, are composed of carbon, oxygen, and hydrogen. Gluten, albumen, fibrin, animal mucus, cafein, &c. contain moreover nitrogen, in addition to these three elements. The ternary or quarternary unions of these four substances in proportion varying *ad infinitum*, give rise to the immediate products of organized bodies; a result clearly proved by the researches instituted by Thenard, Gay Lussac, Berzelius, Prout, Thomson, Berard, Th. Von, Saussure, Ure, and others.

On the other hand, all the inorganic combinations, as Berzelius has shown, are to be considered as binary compositions, that is, resulting from the union of two elements alone, or as combinations of two binary composed bodies, or lastly, as combinations of a binary compound with a simple substance. Thus oxygen with hydrogen produces water; with sulphur, phosphorus, nitrogen, and carbon, it forms sulphuric, phosphoric, nitric, and carbonic acids; in junction with calcuim, soduim and potassium it gives lime, soda, and potassa. Chlorine with hydrogen, originates hydrochloric acid; nitrogen and hydrogen produce ammonia. These salts, then, are only double binary compounds.

* The opinion of chemists are divided regarding the existence of some other simple substances in organic bodies. Thus, Becher asserts that he found gold in the ashes of tamarinds.

It is evident, therefore, that nature has given a more complex composition to organic than to inorganic bodies, a remark which Kielmeyer has already made in his course of general zoology.

IX. Organic combinations can easily be reduced to their elements by chemical operations, and principally by the action of fire, but chemists have not hitherto succeeded in reproducing them, as they have done the inorganic compound bodies.* Sugar, starch, gum, gluten, fibrin, albumen; &c. have been brought down to their elementary principles, but no chemist has yet arrived at the reformation of them in all their parts. The same is the case of all the liquid and solid parts of living bodies On this account, then, we are authorized in admitting that, in the present state of chemistry, the composition of organic bodies is not the effect of affinity alone, but that it depends on powers peculiar to those bodies, by which powers the chemical affinities are swayed.

X. Between organic and inorganic bodies there exists a difference relative to the mode of combination of the materials which enter into their composition and this consists in the greater tendency the former have than the latter to undergo changes and decompositions. The combinations of bodies not endued with life for the most part binary or double binary, are more confirmed, more fixed, and their elements are held together by more energetic affinities than in organic matters, as Che-

* Some chemists assert, that they have obtained organic combinations by submitting inorganic compositions to various modes of treatment; but doubts may be entertained on this subject. Thus Berard (Annales de Chemie et de Physique, vol. v, p. 297) says, he obtained a little crystallized fat by passing one measure of carbonic acid gas, ten of olifiant gas, and twenty of hydrogen through a red-hot tube. It is very probable, that the substances resembling fat which he found was held in solution in the olifiant gas, which had been procured from alcohol Dœbereiner, (Oken's Isis, 1817, art. 5, p. 576,) by passing watery vapour over red-hot charcoal, in an iron tube, got a volatile matter, soluble in water, and having the smell of fat. But it may be objected, that charcoal should be looked on as an organic combination. Besides, Berard and Trommsdorf (Neues Journal fur Pharmacie, vol ii, art. 2, p. 203,) who repeated the experiment, did not obtain the same result. We only are acquainted with two compound organic bodies, of the simple kind namely oxalic acid and urea, which Wœhler first pointed out the mode of procuring from their different components (Poggendorf, Annalder Physik, vol. iii, p. 177.) If chemists have really succeeded in producing, by means of purely inorganic substances, some combinations in which the elements are associated as in organic combinations, it is only those that are placed on the outer boundary between compound organic and inorganic bodiês. Berzaelius (Chimie, book iii, part 1, p. 147,) expresses himself in the following manner on this subject: "Although it may happen that, eventually, it may be discovered that many of these products of matters purely inorganic have a similar composition to that of organic products, yet this, in complete imitation, is always reduced to a very small foundation for hoping that it would ever be in our power to manufacture organic matters from their components, and thus to confirm analysis by synthesis, as we almost always are able to do in inorganic nature."

vreul has shown. For the most part they present solid combustible bodies, which strongly resist decomposition from the atmosphere. On the other hand, the ternary, the quaternary, and even the more complex combinations of the organic kingdom, are less compact and less intimate; they are the results of weaker affinities, which causes them to appear more unsettled and variable, because saturation in them is rarely perfected. The principle of combustion, oxygen, does not exist in sufficient quantities in them, to saturate the combustible elements and to prevent the possibility of their yielding to other affinities. This is the reason why all organic combinations are combustible. For they do not contain the proper quantity of oxygen to saturate their carbon and hydrogen. They burn, when heated, in contact with the atmosphere, and then absorb all the oxygen that is necessary to the saturation of the hydrogen and carbon.

XI. As the elements have a greater inclination to produce binary compounds than to continue in ternary and quaternary combinations, there is observed in organic substances a constant disposition to run into binary states of composition. Inorganic bodies having their elements in a kind of perfect equilibrium, these same elements are but little disposed to combine with surrounding matters, or in any other manner Such is not the case with organic matters, which are more complicated, and retained by less powerful affinities; in them there is observed a constant tendency to resolve themselves. They are mostly composed of oxygen, hydrogen, nitrogen, and carbon, the three first of which are gaseous when in a state of freedom, and strive to abandon the solid form, a tendency which is still more increased by external heat and the heat peculiar to living bodies. The great affinity of the oxygen for the hydrogen and carbon causes it to combine easily with the first, whence results water, and with the second, which produces carbonic acid. Nitrogen, which has a great affinity for hydrogen, joins with it, and gives origin to ammonia. But, as the carbon and hydrogen do not find sufficient oxygen, in organic combinations, to form water and carbonic acid, they have a disposition to attract that of the atmospheric air. On these circumstances depends the facility with which plants and animals run into decomposition, and which rests on the constant tendency of their elements to contract binary combinations, and to quit a state in which they are maintained only by the powers acting in living bodies. Living bodies suffer, by the atmospheric influence remarkable changes, which induce the unfixed elements of food, introduced and rendered fluid in their interior, to undergo, as well by the effect of a subtraction of the materials of the latter, as by an absorption of other principles drawn from the air, a change in their respective proportions, designated under the name of respiration. The manifestations of activity of living bodies themselves, are incessantly modifying organic matters, the composition of which is extremely variable and mobile, and cause them to pass sometimes to a more simple, sometimes to a more complex state, by changing the numerical relations of their elements in such a manner, that vegetable combinations may become animal, and these resume the vegetable state.

XII. There is this difference between living and inert bodies, relative to the connexion of the chemical composition with the configuration, that the former, although they resemble each other most in their composition, nevertheless present a much greater diversity in their forms. What an immense variety of forms the vegetable and animal kingdoms exhibit, notwithstanding the inconsiderable number of elements which constitute living bodies in general. We even find that with an analagous composition, the parts of one and the same organic individual differ in a singular degree from each other in point of configuration. I will mention, as an example, the diversity which petals often present in the same vegetable species and that which is remarked, among animals, in the configuration of the bones and muscles. Inorganic bodies, on the contrary are remarkable, with very few exceptions, for their great analogy of form and crystallization, when their chemical composition is identical.

There must be, therefore, in living bodies a peculiar power, differing from the chemical affinities which determines the forms of bodies not endued with life, and the action of which produces the diversity which organic forms with similar composition exhibit. Or, which expresses the same idea in a still more clear manner, the configuration of organic bodies is not only the effect of chemical affinity, as in bodies without life, but it is also that of a power of a special, or, it may be, a superior nature.

XIII. Regarding the origin of organic combinations, experience teaches us that they are only produced by the manifestations of activity of living bodies already existing. Albumen, gelatin, mucus, gluten, starch, gum, sugar, &c., do not form spontaneously, by the union of elements, or binary compounds, according to the laws of chemical affinity, but only by the manifestations of activity of organic bodies already possessed of life. Organized beings are produced by their fellow-beings, or owe their origin to the matter of organized bodies in a state of decomposition. The production of organic combinations in these beings, takes the name of assimilation and nutrition, whilst the procreation of beings themselves is called generation. On the other hand, inorganic combinations and bodies never originate but from the remains of other more ancient bodies, fallen into dissolution, and the materials of which, under certain circumstances, re-unite to produce them, according to the laws of chemical and mechanical attraction alone.

XIV. Even the most simple animal and vegetable forms, the infusoria, the green matter of Priestley, the conservæ, mouldiness, &c., in what is called spontaneous generation, proceed, according to the observations and experiments undertaken by Needham, Priestley, Ingenhounz, Monti, Wrisberg, Muller, G. R. Treviranus, &c., not from inorganic matters, but from organic bodies and combinations passed into putrefaction or fer-

mentation. It is true, that J. B. Fray * asserts, he has seen infusoria animalculæ developed in pure water. Gruithuisen † says, also, that he saw generated, in an infusion of granite, of chalk, and of marble, a gelatinous membrane, in which, after some time, movements were manifested, and ended by the formation of infusoria, of monanes, and globular animaculæ. But it is very probable that the bodies subjected to experiment, or the water employed in the infusion, already contained organic matter, though in a very small quantity, for other naturalists have not observed the formation of living bodies in infusions of purely inorganic ones.

XV. In all inorganic bodies, particularly crystals, as soon as their materials are brought together and combined by the laws of affinity, the chemical composition remains quiet and it is by this very fact that they subsist. It is not so with living bodies, the composition of which is continually undergoing changes. So long as these bodies act after their manner, that is, so long as they live, they are receiving within them new substances, which they assimilate and introduce into their composition, from which they expel others. It is by the actions of assimilation of food, of respiration, of nutrition, and excretion, that the materials of living bodies are incessantly changing. The composition of these bodies, therefore, is never in a state of quietude. Their tendency to assimilate to themselves new substances, cease only with the extinction of the manifestations of activity, which we call life. But at the same time their existence is stayed, they are destroyed, and lose their form as well as composition. There is then this essential difference between inorganic and living bodies, that the duration of the former depends on the repose in which their composition remains, whilst the existence and preservation of the latter are conditional on a continual change of composition. The cause of this difference is found in the peculiar circumstances, belonging to living bodies, which induce new affinities, and which can only be maintained in action thereby, whereas, when bodies not endued with life are once formed, no further change takes place in the relations of affinity which themselves produce.

XVI. Although during their existence, living bodies are subjected to continual changes, rapid or slow, and introduce within themselves materials obtained from the atmosphere, from matter and from aliments of various kinds, and also free themselves of certain substances, nevertheless they preserve, during a certain lapse of time, the form and composition which is peculiar to them. They have thus the faculty whilst incessantly changing their composition, of retaining their qualities, and even of resisting to a certain extent, chemical influences from without. (‡) All inorganic bodies, on the contrary, being only the simple product of affinities, the property of substances which constitute them, are deprived of the power of re-acting on the external impressions which produce changes in them, and are delivered up to the play of chemical affinities. For instance, when a crystal has been placed in contact with an acid which has an affinity for its base, the latter combines with the acid, in such a manner that the form and composition of the crystal are changed and destroyed.

We can attribute this property which organic bodies possess of resisting, to a certain extent, the purely chemical actions of external things, to no other than peculiar powers which sway the affinities. This results from the consideration, that so soon as their vital powers are extinguished, exterior influences guided by the laws of chemical affinities, produce likewise in them, changes tending to the destruction of the form and composition peculiar to them. After the death of an organized body chemical affinities enter into play, so that its form and composition, which, during an age or more, had frequently braved the destructive action of external things, are done away within a short space of time.

XVII. The chemical operations of putrefaction and fermentation, which are established after the extinction of the special powers, whose action counterbalances, during the life of organized bodies, that by which the chemical affinities of external things tend to destroy them, and which change at once their composition and their form, are phenomena of a particular nature, that are not observed in the decomposition of inorganic bodies. They are organico-chemical processes. The decomposition which takes place after death has, in ordinary cases, its limits, and the organized materials do not altogether enter, but only in part into the inorganic kingdom, since they are neither completely reduced to their elements, nor converted into binary combinations.

XVIII. The organic combinations or matters, albumen, starch, gluten, gum, animal mucus, fibrin, gelatin, &c. as well as the animal and vegetable tissues into which they enter, possess the peculiarity, when placed in favourable external circumstances, exposed to a certain degree of heat, of light, and humidity and in contact with the asmosphere, of passing to new simple organic forms, as soon as they have been detached from the organic combination of any being. This is what happens in fermentation and putrefaction, where the resolution of organic combinations gives rise, according to the composition of the latter, and external influences sometimes to infusoria, sometimes to the green matter of Priestley or to mouldiness. This property which organic matters enjoy, of taking a new form under

(*) Essai sur l'Origine des Substances Organisées et Inorganisées. Berlin, 1807.—Essai sur l'Origine des Corps Organisèes et su quelques Phénomènes de Physiologie Animale et Végétale. Paris, 1817.

(†) Ueberdie Chemischen und dynamischen. Momente bei der Bildung der Infusorien mit einer Kutik der Versuche Fray's : in Gehlen's Journal der Physik, vol. viii. p. 150.

(‡) Nevertheless, when living bodies are exposed to a very high or a very low temperature if they be placed in contact with certain kinds of gas, or if concentrated mineral acids or caustic alkalis be made to act on them, they may even then be destroyed by these different agents.

certain circumstances, shall be designated provisionally, under the name of aptitude for life or plasticity. It is only extinguished when these matters are reduced to their elements, as whenever fire is made to act upon them. Thus, when the manifestations of activity, called life, are done away with in the matters of the peculiar kind appertaining to organic bodies, and the chemical operations of the special nature which occur in them after death, that is, putrefaction and fermentation are established, these matters do not enter completely into the inorganic kingdom, but retain the power of putting on a new form, and of showing themselves adapted to the enjoyment of life. Death, then, or the extinction of the manifestations of life only bears upon organic individuals, whilst the organic matters entering into the composition of these beings continue to be capable of taking on form and receiving life.

XIX. The principal result of the comparisons made between the composition of organic bodies and those of inorganic bodies, which comparisons are founded on observations and researches in the chemical composition of these bodies hitherto pursued, is that the former have peculiar matters, which we call organic, for their basis. The changes of composition which take place in bodies endued with life, are not simply the effects of affinities similar to those observed in brute or inorganic bodies; they are the effects of affinities and forces of a special nature. Organic matters are the only ones which exhibit, and for the greater period of time in a particular state of aggregation and form called organization, the manifestations of activity which we designate by the name of life. They are accumulated at one time in bodies actually living, and life is manifested in them; at other times they are exterior to living bodies, mixed with inorganic matters, and then only capable of living. In this latter state they may return to domain of living bodies, and into the tide of life, either in the shape of aliments, or, in a direct manner, by the aid of certain circumstances, as happens in spontaneous generation. Purely chemical affinities, or the action of simple chemical forces, appear, in the present state of our planet, to produce no organic combination or matter, such as albumen, gelatin, starch, gluten, &c.; at least we possess no facts which go to support the contrary opinion. None but organic bodies themselves are capable of introducing inorganic matters into organic combinations, of which respiration in particular and the nutrition of plants are examples.

XX. If we extend our researches still further, a question presents itself, namely, how organic matters, their different combinations and living bodies, are formed in our planet? The solution of this problem passess the limit of our experience. Should we, however, wish to hazard an answer to it, we fall into the waste of conjecture, and are forced to erect hypotheses, which are but probable, and not at all certain. We suppose that organized bodies have existed in our planet from its commencement; or else we admit that organic matters and living bodies have been produced, under certain circumstances, together with the elements and organic matters, by the action of general physical causes; or, lastly, we conjecture that the substance of living bodies was primatively contained in water, as primitive organic matter, having the property of taking on the organic form, that it gave origin to organic bodies of very simple and varied kinds in consequence of circumstances, and that these bodies have passed successively to more complicated forms, until at length the generative organs and their manifestations of activity having appeared in them, they were endowed with the faculty of preserving themselves in a continuous manner, by means of generation, as separate species.

XXI. Geology is opposed to the first hypothesis of the existence, in our planet, of living bodies from the first moments of its creation. Fossils are found only in the exterior crust, that is to say, in the superficial layers of the earth, the formation which is most recent, whilst there are none at all in the primitive earths. Consequently there was a time when no living being existed on the globe. Even supposing we admitted this hypothesis, we should still leave untouched the question, how living bodies were formed; in as much as we could say nothing concerning the mode of origin of our planet and of the bodies which constitute it. In reference to this qnestion, it matters little whether we declare for vulcanism, or neptunism, since the geologists are under the necessity of leaving the origin of fire and water without explanation, and the biologist is still less able to pronounce any opinion on that of living bodies.

XXII. The difficulties which occur in the second hypothesis, of the dependence of the production of organic matters and living bodies on the action of general physical forces, are that we are actually in want of facts which would authorize us to conclude analogically that organic matters and living bodies can proceed from inorganic matters, never having observed any thing similar, at least up to this day. Far from this being the case, living bodies are unable to produce, with inorganic substances, the greater number of the materials which enter into their composition, and for such end they require the matter of other organic bodies, which they introduce into themselves. Plants are nourished principally by the remains of dead vegetables or animals: animals likewise preserve their existence by means of vegetables, and even of other animals.

XXIII. The most probable hypothesis is the third, viz., that the substance of organic bodies existed primatively in water, as a matter of a particular kind, and that it was there endowed with the plastic faculty, that is to say, with the power of acquiring, by degrees, different simple forms of living bodies, with the concurrence of the general influences of light, heat, and perhaps also of electricity, &c., and of then passing from the simple forms to other more complicated, varying in proportion to the modification occurring in the external influences until the point when each species acquired duration by the production and manifestation of activity of the genital organs.

Although we cannot here also answer the question, whence came the water and the organic matter which it contained, yet this hypothesis is the one which accords best with the facts with which geology has latterly been enriched. In fact, we find no organized bodies belonging to what is called the primitive world in the strata of earths which modern geologists consider as the products of fire or of vulcanism. They are only observed in the upper layers of the earth, in those of the latest formation, and in the soils which have evidently been precipitated in the midst of the waters. Aquatic animals existed before terestrial animals. An argument which favours the hypothesis according to which the organic kingdom has been gradually developed and elevated from simple to more complicated forms, is drawn from the fact that we meet with remains of organic bodies belonging to the most simple species in the secondary and more ancient soils, whilst the most recent strata of the earth contain the remains of more complicated living bodies. The soils which rest directly on primitive rocks, present fragments of corals, radiated animals, and shells. It is only after these that remains of vertebrated animals, fishes, reptiles, and cetacea, are found in the water. Fossil bones of oviparous animals exist in the deep strata of the earth, whereas the viviparous mammiferæ are met with in the superficial layers. We observe the same in the organic complication of vegetables, whose remains are contained in the different layers of the earth. Impressions of cotyledonous plants, especially of ferns, are the first vegetable traces met with in the deep seated strata. Then come the remains of monocotyledonous plant, of arborescent gramina, of palms, &c., and finally those of the coniferæ and other dicotyledonous plants.

There have not yet been found any fossils belonging to apes or man, whose organization has reached the highest degree of complication and development. We may therefore admit, with great probability, that apes and men are the last and the newest products of our planet.*

XXIV. Another circumstance favourable to the hypothesis of the gradual development of organic bodies, from the most simple to the most complicated, is that all those bodies, as well vegetables as animals, to this day appear in a simple form, at the period of generation, or when they proceed from the germ, and that it is only by degrees they acquire the most complex form peculiar to each species. To commence in a very simple manner, and to rise thence to the complicated, is the general character of every thing that has life, as well of individuals as of the entire of the organic kingdom.

XXV. These reasons, coupled with the fact that, after the extinction of the life of individuals, the materials of organized bodies are reduced to the most simple organic forms by the action of what is called spontaneous generation, oblige us to admit a primitive organic matter extended on the surface, or in the crust and waters of our planet, concerning the first origin of which matter it is as possible for us to certify any thing as on that of the planet itself. This organic matter, with its different organic modifications, considered as matters of a peculiar species, sometimes is seen active and living in the individuals of vegetable and animal species actually existing, under conditions and in the midst of phenomena, the recital of which will be made hereafter; at other times remains merely capable of enjoying life, and endued with the faculty of taking on in certain circumstances, the most simple organic forms, whenever it has been withdrawn from the composition of living bodies.

Several naturalists, particularly Buffon* and Needham,† have allowed the existence of a matter peculiar to living bodies. G. R. Treviranus‡ concludes from his researches on life.

1. That there is in nature a matter which is ever moving, by which all living beings, from the byssus to the palm, and from the infusoria animalculæ to the sea monster, possess life, and which, though immutable in its essence, is notwithstanding variable in its form, and is incessantly changing it.

2. That this matter is deprived of form in itself, but nevertheless ready to take that of life; that it maintains a determinate form under the influence of external causes; that it only continues in that form so long as these causes are active, and that it takes another so soon as new causes influence it.

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* An additional argument in favour of this hypothesis, is the fact that whenever animal matter shall have lost that power which gave and maintained it in a higher degree of complication in form and functions—no matter how high this degree—it invariably returns to the most simple forms. The noble human form, after the cessation of the functions, possesses only sufficient plasticity to take on the shape of the lowest insects and worms. The same applies to the kingly lion of the forest and the soaring eagle. In fact, the matter composing each of these, after death, is in the same state as the matter which is described by Tiedemann as possessing merely the aptitude for life, and therefore taking on only the most simple form. Again, that external circumstances modify structure, is very well ascertained. The absence of light generally causes a mother to produce a deformed child, as Edwards observed in females confined in dungeons, whilst, tadpoles, preserved from the light, became huge tadpoles instead of frogs. Natives of different climes have different parts of their organization prominently in action; the muscular system, for instance, is much more developed in cold than warm climates; on the other hand, natives of the tropics are from birth more excitable than those of northern parts of the globe; in other words, the animal nervous apparatus is more developed. In a pure hypothesis it is not expected that the modus operandi of the circumstances to which Tiedemann alludes should be explained; collateral evidence is certainly in favour of it.—Transl.

* Hist. Nat., vol. ii. p. 420. Il existe une matière organique animée, universellement rependue dans toutes les substances animales ou vegetables, qui sert egalement àleur nutrition, à leur developpement, et à leur reproduction.

† An Account of some new Microscopical Discoveries. London, 1745, in 8vo.

‡ Biologie, vol. ii. pp. 267 and 403.

3. That the matter capable of life, and the living principle, exist reciprocally, and that death is only a passage of certain forms of this matter to certain others.*

PHILOSOPHICAL TRANSACTIONS.

PART II.

This portion of the transactions of the Royal Society contains several important papers, especially in the department of electricity. The contents are :

On some Elementary Laws of Electrity. By W. Snow Harris, F. R. S.

On a general method in Dynamics. By W. R. Hamilton, Esq.

An Investigation of the Laws which govern the motion of Steam Vessels, by P. W. Barlow, Esq.

On the generation of the Marsupial Animals. By R. Owen, Esq.

Observations on the structure and functions of tubular and cellular Polypi and of Ascidiæ. By Joseph J. Lister, Esq.

On the nervous system of the Sphynx Ligustri. By G. Newport, Esq.

Experimental Researches in Electricity, 8th series. By M. Faraday.

On the functions of some parts of the brain. By Sir Charles Bell.

On the repulsive power of Heat. By the Rev. B. Powell.

On the equilibrium of a mass of Homogeneous Fluid at liberty. By James Ivory, Esq.

Observations on Torpedo. By John Davy, M. D.

Remarks in reply to Dr. Daubeny on the air disengaged from the recent Volcano. By John Davy, M. D.

On the ova of the Ornithorynchus Paradoxus. By R. Owen, Esq.

Observations on the motions of Shingle Beaches. By H. R. Palmer, Esq.

Analysis of the Moira Brine Spring. By A. Ure, M. D.

Experiments on the Velocity of Electricity, &c. By C. Wheatstone, Esq.

ELECTRICITY.

By Mr. Harris.

Mr. Harris for the purpose of prosecuting his researches invented a new electrometer, by the medium of which he has observed two new laws. 1. A given quantity divided upon two perfectly similar conductors, was found to exert upon external bodies only a fourth part of the attractive force apparent when disposed upon one of them. 2. When divided upon three perfectly similar conductors, the force upon either is only one ninth of the force apparent when disposed upon one of them, and so on; that is, the quantity being constant, the force is as the square of the surface inversely, or the surface being constant as the square of the quantity directly. These are illustrated by the following experiment:

Three or four perfectly similar and equal conductors of a cylindrical form being well insulated, a given quantity of electricity was communicated to one of them by means of a charged jar, and the attractive force measured by the electrometer. The electrified bodies being now reduced to a neutral state, a second equal quantity was again communicated to the same conductor as before, after which it was caused to touch one of the others so as to divide the charge on both. Each conductor was observed to be equally charged; the force however after making the requisite correction for distance between the attracting bodies amounted only to one fourth of the previous force. The results are represented in the following table :

Comparative quantity.	Force in degrees.	Distance of attracting surfaces	Force at distance of an inch.
1	30°	1	30°
½	5— ..	1·25	7.8—
⅓	2+ .	1 28	3·27+
¼	1+ ..	1·29	1·8+

2. The author distinguishes three elements peculiar to the condition, of electrical accumulation. 1. The comparative quantity actually accumulated. 2. The quantity not sensible to the electrometer. 3. The quantity appreciable by the electrometer.

3. It was supposed by Mr. Singer, that the diminished insensity observable in disposing a given quantity of electricity, is altogether referable to the attractive force of the atmosphere, to the influence of which the electric particles become more extensively exposed but this hypothesis is not corroborated by the experiments of M. Harris. He placed a brass ball about two inches in diameter in the centre of a large receiver, and connected it with an electroscope by means of a brass rod passing right through a collar fixed in a glass plate and socket. A quantity of electricity was communicated to the ball, sufficient to cause a divergence of 40° in the electroscope. This effect was not influenced by removing fifty-nine sixtieths of the air in the receiver.

4. In reference to the transmission of electricity between conductors, it appears that when the attracting force operating between two conductors can overcome the atmospheric pressure, a discharge ensues between the nearest points of the opposed surfaces. In these points the force appears to become a length indefinitely great in respect of points more remote, so that the whole quantity accumulated is finally determined through them. Thus the precise points of contact between two spheres being found, and the spheres subsequently separated by given distances measured between these points, it may be shewn that the respective quantities requisite to produce a discharge will vary with the distance directly. The distance at which electricity can be discharged in air of

* This has reference only to the power of life inherent in matter, and is a question of science only. The soul is not concerned nor mentioned. It may be necessary to state this, as there are those who would startle at a sentence which, in fact, asserts that life is material and matter eternal, leaving one form only to take on another. The stupid outcry against the phrenological doctrine, and the exclamations concerning its inculcation of materialism, have a foundation in a precisely similar error, that of mistaking the principle capable of life in matter for the soul.—Transl. Thus the researches of Philosophy have a limit and bespeak the power and Majesty of God.—Edit.

a given density is an accurate measure of the comparative quantity contained in a unit of space, or of the tension (by which is to be understood the elastic force of a given quantity accumulated in a given space, and is directly as the density of the stratum,) and the attractive force discovered by the electrometer, or the intensity is directly as the square of the quantity contained in a unit of space.

5. The effect of an atmosphere varying in density and temperature in restraining electrical discharges, is as follows :

1st. The respective quantities requisite to pass a given interval, varied in a simple ratio of the density of the air. When the density was one half as great, the discharge occurred with one half the quantity accumulated, that is to say, with one fourth of the attractive force indicated by the electrometer. 2nd The distance through which a given accumulation could discharge was found to be in an inverse simple ratio of the density of the air, the intensity or free action being constant. In air of one half the density, the discharge occurred at twice the distance, or the resistance of air to the passage of electricity is as the square of the density directly, and if the density of the air be decreased, the distance between the points of action be increased, the electrical accumulation will still remain complete.

6. Heated air is not as is frequently stated a conductor of electricity, and heat does not facilitate electrical transmission through air in any other way than by diminishing its density. Supposing heat to be material, it is a non-conductor of electricity, because the incorporation of a conducting with a non-conducting substance is found to impair the insulating power of the latter as in the case of air charged with free vapour, whereas in the intimate union of two non-conductors the insulating power remains perfect.

7. Sir Humphry Davy has well illustrated the effect of heat in imparing the conducting power of metals, and the same fact has been observed by Mr. Christie. Dr. Ritchie, however, has lately brought forward an objection ; for, in transmitting electricity over a forked iron rod, one of the legs of which he heated to redness, he found that the electricity passed in preference from the heated side rather than from the cool side. To make this experiment free from objection, it would be necessary to insert the heated iron rod in an exhausted receiver. Dr. Ritchie was aware of this, but conceives that the effect of a heated wire would be a species of electrical evaporation from its surface. His very ingenious paper in the philosophical transactions has certainly not attracted that attention which it deserves. The objection stated to his experiment by Mr. Harris, does not appear to affect the result which he obtained.

8. Volta observed that of two plane surfaces of equal area, that which has the greatest extension has also the greatest capacity for electricity. Mr. Harris has prosecuted this fact and ascertained that the intensity varies in an inverse ratio of the perimeter of plates which he employed, varying in shape from a circle through a square up to a long parallelogram. The following illustrates the results—

DIMENSIONS,—AREA=75 SQUARE INCHES.

Length.	Breadth	Perimeter.	Intensity.
12 5	6	37 inches	9?
25·	3	56 ,,	6
54·5	1·4	112 ,,	3

The extent of edge has no influence on the intensity. The intensities of conductors are therefore, it appears, inversely as their perimeters, and the intensity varies in an inverse ratio of the area when the perimeters remain the same, from which, it follows that the intensity must vary inversely with those quantities jointly or calling I, intensity, A, area, P, perimer, we have

$$I \ a \ \frac{1}{AP}$$

But suppossing the quantity of electricity to vary, then the intensity being as the square of the quantity, the formula is

$$I \ a \ \frac{x}{AP}$$

and the capcity of a conductor being measured by the quanacty of electricity, it can receive under a given intensity, there follows $x2$ a I A P, or with a constant intensity, x representing the capacity, we obtain capacity

$$a \angle \frac{}{AP}$$

It appears that the intensity does not vary in an inverse ratio of the square of the surface according to the general law, except when the areas are so disposed that the whole perimeter of the various plates is as the respective surfaces.

9. The operation of electricity on distant bodies, by induction, is quite independent of atmospheric pressure, and is exactly the same in vacuo as in air, the attractive force varying as the squares of the respective distances inversely.

1*st*. The attractive force exerted between an electrified and a neutral uninsulated conductor, is not at all influenced, by the form or disposition of the unopposed portions.

2*d*. The force is as the number of attracting points in operation directly, and as the squares of the respective distances inversely, hence the attractive force between two parallel place circles being found, the force between any other two similar planes will be given.

3*d*. The attractive force between two unequal circular areas is no greater than that between two similar areas each equal to the lesser.

4*th*. The attractive force also of a mere ring and a circular area on each other, is no greater than that between two similar rings.

5*th*. The force between a sphere and an opposed spherical segment of the same curvature, is no greater than that of two similar segments, each equal to the given segment.

It has been much agitated whether electricity can pass through a vacuum, but the fact

is, that as it is impossible to produce such absence of matter by artificial means, it seems unnecessary to dwell upon it.

The experiments of Harris go to prove that electrical divergence completely independent of atmospheric attraction, and is therefore in accordance with the opinion with which he sets out, that electricity is a subtle material agent, essentially involved in the constitution of ordinary matter. The experiments, however, upon which such deductions can be founded, it is obvious, must be conducted with the greatest delicacy, and in such cases, absolute certainty is scarcely to be looked for.

EXPERIMENTAL RESEARCHES IN ELECTRICITY.

8th, Series.

By M. Faraday.

The paper of Dr. Faraday constitutes the Eighth Series of his researches in electricity, and consists of corrected and extended views of the theory contained in his Fifth and Seventh Series. The whole paper is pregnant with important matter. It has been objected to Dr. Faraday's papers on electricity that they are difficult to understand, in consequence of the new nomenclature which he has introduced, and perhaps there is reason, in some instances, in similar complaints, for surely, it is said, when plain English words can express facts or opinions, it is improper to substitute technical expressions, either in science or literature; and a language which can muster, in alphabetical array, seventy-five thousand words, does not stand in need of unnecessary innovations. Such observations, however, do not apply in the present instance: because, the new terms are few, and obviate much circumlocution. They may, however, be attended to with propriety by those who are only entering upon discovery. In medicine, more especially, it is too obvious that technicalities have served, in many instances, to form cloaks for ignorance and quackery.

In the present series, the author enters upon the investigation of the important point whether the supply of electricity is due to metallic contact or chemical action. For the purpose of determining this point, he took a plate of zinc, about eight inches long and half an inch wide, which was cleaned and bent in the middle to a right angle. A plate of platinum, about three inches long and half an inch wide, was fastended to a platinum wire, and the latter bent to a right angle. These two pieces of metal were arranged together, but outside a vessel, and its contents, which consisted of dilute sulphuric acid, mingled with a little nitric acid. A piece of folded bibulous paper, moistened in a solution of iodide of potassium, was placed on the zinc, and was pressed upon by the ends of the platinum wire. When under these circumstances, the plates were dipped into the acid of the vessel described, there was an immediate effect at the bibulous paper, the iodide being decomposed, and iodide appearing at the *anode*, *i. e.*, against the end of the platinum wire. As long as the lower ends of the plates remained in the acid, the electric current continued, and the decomposition of the iodide proceeded. On the removing the end of the wire from place to place on the paper, the effect was evidently very powerful, and on placing a piece of turmeric paper between the white paper and zinc, both papers being moistened with the solution of iodide of potassium, alkali was evolved at the *cathode*, against the zinc, in proportion to the evolution of iodide at the *anode*. Hence the decomposition was perfectly polar, and decidedly dependent upon a current of electricity passing from the zinc through the acid to the platinum in the vessel, and back from the platinum, through the solution to the zinc at the bibulous paper. The fact of the decomposition being produced by the electrical current, was proved by the circumstance of the decomposition ceasing when the acid and its vessel were removed from the plates, and being again removed when the contact was repeated. The same position was deduced by varying the experiment, amalgamating pieces of zinc over the whole surface, and employing dilute sulphuric acid in the vessel. The same effects resulted when caustic potash was used instead of acid, and also when brine was substituted. The inferences which the author draws are, 1*st*. That metallic contact is not necessary for the production of the voltaic current; 2*d*. That a most extraordinary mutual relation of chemical affinities of the fluid exists which excites the current and the fluid which is decomposed by it.

The use of metallic contact in a single pair of plates appears evident from the experiments. For when an amalgamated zinc plate is dipped into dilute sulphuric acid, the force of chemical affinity exerted between the metal and the fluid is not sufficiently powerful to cause sensible action at the surfaces of contact, and occasion the decomposition of water by the oxidation of the metal, although it is sufficient to produce such a condition of the electricity as would produce a current if there was a path open for it.

Now, the presence of a piece of platinum touching both the zinc and the fluid to be decomposed opens the path required for the electricity, because only one set of opposing affinities are to be overcome; whereas, when metallic contact is not allowed, two sets of opposing affinities must be conquered. Some have considered it impossible to decompose bodies by Hare's calorimeter, or Wollaston's powerful single pair of plates, but this was owing to their considering the decomposition of water a test of the passage of an electric current. But the author observed that bodies would differ in facility of decomposition by a given electric current, according to the condition and intensity of their ordinary chemical affinities, and he has corroborated the fact by new experiments. In employing different fluids to excite the action, he procured currents of electricity varying in intensity and by consequence in their defects. Dilute sulphuric acid acting upon the zinc and plati-

num plates decomposed *iodide of potassium*, *protochloride of tin*, *chloride of silver*, but water acidulated with sulphuric acid, solution of muriatic acid, solution of *sulphate of soda*, fused *nitre*, and the fused *chloride* and *iodide of lead*, were not affected by a single pair of plates excited only by dilute sulphuric acid. All these substances were, however, readily decomposed by adding a little nitric acid to the dilute sulphuric acid. It is sufficiently obvious that the addition of the nitric acid operated by increasing the intensity or power of the current.

By the reference which is thus made of the intensity of the electric current to the intensity of the chemical action, the conclusion is drawn that by using bodies such as fused chlorides, salts, &c., which may act upon the metals with different degrees of force, effects would be obtained due to different intensities, which would serve to assist in the construction of a scale, so as to supply the means of determining relative degrees of intensity accurately in future researches. The bodies which have been examined are decomposed in the following order, the first being disunited by the current of the lowest intensity. Iodide of potassium (solution.) Chloride of silver (fused.) Protochloride of tin (fused.) Chloride of lead (fused.) Iodide of lead (fused.) Muriatic acid (solution.) Water acidulated with sulphuric acid.

Another proof that metallic contact has nothing to do with the production of electricity, and that electricity is only another mode of the exertion of chemical forces, is the production of the electric spark before the metals are brought in contact, and by the influence of pure chemical agency in an experiment where the spark is obtained by placing in contact a plate of zinc and a plate of copper, and plunging them in dilute sulphuric acid.

The principles which the author endeavours to establish in the course of his researches are that the electricity of the voltaic pile is not dependent either in its origin or its continuance to the contact of the metals with each other. It is entirely due to chemical action, and is proportionate in its intensity of the affinities concerned in its production, and in its quantity to the quantity of matter which has been chemically active during its evolution. The production of electricity is a case of chemical action, while electric decomposition is simply a preponderance of one set of chemical affinities over another set which are less powerful. The source of the electricity exists in the chemical action which takes place directly between the metal and the body with which it combines, and not in the subsequent action of the substance so produced with the acid present. Thus if zinc, platinum, and muriatic acid are employed, the electricity depends upon the affinity of the zinc for the chlorine, and circulates in proportion to the number of atoms of the zinc and chlorine which unite. But for this direct action upon the metal itself, it is essential that the oxygen or other body be in the state of combination, and limited to the state of an electrolyte, that is a body which is decomposed when the electric current is transmitted through it.

Some bodies there are which are capable of exerting chemical action upon the metals which are not electrolytic; but these must be chosen from among the metals; charcoal also answers. No electric current is however induced by these means. An electrolyte is always a compound body, and can act as an electric conductor only when decomposing. Water is the most familiar electrolyte. The attraction of the zinc for the oxygen is greater in the case of water than that of the oxygen for the hydrogen, but in combining with it, it tends to throw into circulation a current of electricity in a certain direction. The sulphuric acid used in the voltaic circuit is not capable of producing any sensible portion of the electricity of the current, by its combination with the oxide formed, because in it forms no part of an electrolite, nor is it in relation with any other body present in the solution which will permit of the mutual transfer of the particles, and the consequent conduction of the electricity. Now, an electrolyte conducts in consequence of the mutual action of its particles, but the elements of the water and sulphuric are destitute of this relation. This corroborates the statement of Sir H. Davy, that no electric current is induced by the combination of acids and alkalies. If the acid and base be dissolved in water, it is possible that a small portion of electricity, proceeding from chemical action, may be conducted by the water without decomposition, but the quantity will bear no proportion to the equivalents of chemical force. If a hydrogen acid be used, then a current may be induced by the chemical action of the acid on the base, for both bodies now act as electrolytes.

This view of the oxidation of the metal being the cause of the electric current, is proved by the effects of alkaline and sulphuretted solutions when used as conductors. It cannot be supposed that the alkali acts chemically as an acid to the oxide formed, because our knowledge leads to the conclusion that the ordinary metallic oxides act rather as acids to the alkalies. Ammonia as well as potash produced the same electric currents. Alkalies seem not to be influenced by the acids, in effecting electrical currents, but are superior in force and in bringing a metal into what is called the positive state. It is proved by the fact that if zinc and tin be used, or tin and lead, whatever metal is put into the alkali becomes positive, that in the acid being negative. Davy shewed that if iron and copper were plunged into dilute acid, the current passed from the iron through the fluid to the copper. In the solution of sulphuret of potash it is reversed. Two experiments in addition complete the series of proofs of the origin of electricity on the voltaic pile. A fluid amalgam of potassium containing not more than $\frac{1}{100}$ of that metal was put into pure water, and connected through the galvanometer with a plate of platinum in the same water; a current passed from the amalgam to the platinum, which must have been owing alone to the oxidation. Again, a plate of clean lead and a plate of platinum were placed in pure water, a current passed from

the lead to the platinum, so intense as to decompose a solution of the iodide of potassium, when acted upon in the manner described at the beginning of the paper. This likewise appears to have been an instance of the effect of oxidation.

An important point to determine is the state of the metals and the conductor in a simple circuit, before, and at the instant when the metallic contact is completed. Dr. Faraday conceives it impossible to resist the idea that the voltaic current which we have seen is dependent upon oxidation, must be preceded by a state of tension in the fluid, and between the fluid and the zinc, the first consequence of the affinity of the zinc for the oxygen of the water. He endeavoured to investigate this by transmitting a ray of polarized light through a solution of sulphate of soda across the course of the electric current, and examined it by an analyzing plate, but though it penetrated seven inches, not the slightest trace of action on the ray could be detected, nor was the effect different when nitrate of lead was substituted. A beautiful experiment proves a state of tension acquired by the metals and the electrolyte before the electric current is produced, and before the metals are brought in contact. He took a voltaic apparatus consisting of a single pair of large plates, namely, a cylinder of amalgamated zinc and a double cylinder of copper, and placed them in a jar containing dilute sulphuric acid, so that they could at pleasure be placed in metallic communication by means of a copper wire, arranged so as to deposit the ends into two vessels of mercury connected with the two plates. As long as the plates were kept separate no action occured; but when connected, a spark (contrary to the common idea) was elicited, and the solution decomposed. Hence, it appears that as the electricity is produced by the material action of the zinc and water, so these by being brought in contact are placed in a state of powerful tension, which, although it did not decompose the water, caused a spark to pass between the zinc and a fit discharger when the interval was small enough. The idea which Berzelius has broached that the heat and light of combustion are the consequences of the action of chemical affinity, without the production of an electric current, appears to the author to be a mere imagination.

With regard to the direction of the movement of evolved and combining bodies, it appears that if in a voltaic circuit, the activity of which is determined by the attraction of zinc for the oxygen of water, the zinc move from right to left, then any other *action* included in the circuit being part of an electrolyte will also move in the same direction, and as the oxygen of the water by its natural affinity for the zinc, moves from left to right, so any other body of the same class with it, *i. e.* any *union* will follow the same course.

These statements of our author correspond with hegeneral views of Davy in his Bakerian lecture.

(*To be continued.*)

ON THE ACCIDENTAL COLOURS OF CERTAIN SOLUTIONS ON MERCURY.

By Charles Tomlinson, Esq.

To the Editor of the Records of General Science.

Dear Sir,—In the course of my experiments on Visible Vibration, I noticed a ready and convenient method of observing accidental colours without fatiguing the eye, which was new to me, and will, I hope, prove interesting to some of the readers of your Journal.

Having occasion to diminish somewhat the reflecting surface of mercury contained in a foot glass, I poured about an ounce of a solution of litmus, which had become slightly reddened by exposure to the air, upon the surface of the mercury, when the upper portion of the glass above the fluid was reflected twice, the lower reflection by the mercury and the upper one by the litmus solution. On placing the finger on the periphery of the glass, and bringing one eye near to another part of the periphery, two reflections of the finger were seen; one the colour of the litmus, a beautiful purple inclining to red, and the other a delicate light green, its accidental colour.

On adding a few drops of nitric acid to the litmus solution, the accidental colour was of a dark and decided green.

With mercury and a solution of chromate of potash a fine blue accidental colour was obtained.

With muriate of lime the same result was obtained with this addition : on looking steadfastly into the glass with one eye, the other being closed, a variety of white spots began to form on the iris, giving the eye an unpleasant mouldy sort of appearance. The aqueous humour seemed to consist of one isolated drop of water, so distinct from any other part of the eye, that it seemed as if it would have dropped down into the glass; in a short time the transparent membrane covering the pupil became milky, and the glass and fluids indistinct. I have repeated this experiment with the same results, except that the white spots on the iris were not so numerous.

With a deep blue solution on mercury obtained by indigo in sulphuric acid, the accidental orange-yellow was obtained.

These accidental colours are neither modified nor changed by the reflection of various coloured solids, such as blue, yellow and green balls, &c., the accidental colour belonging to the upper fluid and not to the object reflected. In order to obtain them, however, two liquids of different densities must be employed in order to obtain two reflections, and for the lower fluid nothing is so convenient as mercury. Indeed, I have not as yet met with any other fluid that at all answers the purpose.

The effect is very beautiful with litmus solution and mercury when the flame of a candle is employed; the two reflections have the appearence of hollow cones placed above

and within each other, the lower flame being the accident.

With muriate of lime the lower flame reflected by the mercury was of a decided yellow, but the accidental colour of a very faint blue; whereas, by natural light the accidental is of a fine indigo.

The green flame obtained by boracic acid in alcohol presents a very fine appearance with litmus and mercury. A watch glass should be employed supported on a ring formed out of a piece of wire, and other lights in the room extinguished.

Your,

Dear Sir, very sincerely,

CHARLES TOMLINSON.

Brown Street, Salisbury,
April 22, 1835.

ON CALICO-PRINTING.

BY THOMAS THOMSON, M. D., F. R. S. L. & E. &c.,
Regius Professor of Chemistry in the University of Glasgow.

[We cannot, in our opinion render a greater benefit to some of our Civil Surgeons who have much leisure time than introduce to their notice recent improvements during 1835 in the manufactures. They may be turned to great advantage.]

CALICO-PRINTING is the art of applying one or more colours to particular parts of cloth, so as to represent leaves, flowers, &c., and the beauty depends partly on the elegance of the pattern, and partly upon the brilliancy and contrast of the colours. The process is not confined to *cotton cloth*, as the term *calico-printing* would lead us to suppose. It is applied also to linen, silk, and woollen cloth; but as the processes are in general the same, I shall satisfy myself with describing them as applied to cotton, because it is with them that I am best acquainted.

The general opinion is, that this ingenious art originated in India, and that it has been known in that country for a very long period. From a passage in Pliny, who probably composed his Natural History about the middle of the first century of the Christian Era, it is evident that calico-printing was understood and practised in Egypt in his time, but unknown in Italy.

"There exist in Egypt," says he, "a wonderful method of dyeing. The white cloth is stained in various places, not with dye-stuffs, but with substances which have the property of absorbing *(fixing)* colours. These applications are not visible upon the cloth; but when the pieces are dipt into a hot caldron containing the dye, they are drawn out an instant after, dyed. The remarkable circumstance is, that though there be only one dye in the vat, yet different colours appear on the cloth; nor can the colours be again removed.*"

* Plinii Hist. Nat. lib. xxxv. c. 11.

That this description of Pliny applies to calico-printing, will be evident to every person who will take the trouble to read the account of the processes which we are going to give.

The colours applied to calico in India, are beautiful and fast. The variety of their patterns, and the great number of colours which they understood how to fix on different parts of the cloth, gave to their printed calicoes a richness and a value of no ordinary kind. But, their processes are so tedious, and their machinery so clumsy, and they could be employed only where labour is so cheap as to be scarcely any object to the manufacturer. It is little more than a century and a half since calico-printing was transferred from India to Europe, and little more than a century since it began to be understood in Great Britain. The European nations who have made the greatest progress in it, are Switzerland, France, especially in Alsace, some parts of Germany, Belgium, and Great Britain.

In Europe, the art has been in some measure created anew. By the application of machinery, and by the light thrown on the processes by the rapid improvements in chemistry, the tedious methods of the Indians have been wonderfully simplified; while the processes are remarkable for the rapidity with which they are executed, and for the beauty and variety and fastness of the colours.

I propose in this paper to give a sketch of the different processes of calico-printing, such as they are at present practised by the most skillful printers in Lancashire, and in the neighbourhood of Glasgow.*

PRELIMINARY PROCESSES.—The cotton cloth, after being woven, is subjected to several preliminary processes, before it is fit for calico-printing. It will be sufficient merely to allude to them. They are *singeing* and *bleaching*. The singeing is intended to remove the fibers of cotton which protrude on the surface of the cloth. This is done by passing the cloth rapidly over the surface of a read-hot iron cylinder, which burns off all the hairs, or protruding fibres of the cotton, without injuring the cloth. Of late years, an ingenious coal-gas apparatus has been substituted for the red-hot-iron, both in Manchester and Glasgow.

The bleaching of cotton consists essentially of four different processes. 1. The cloth is boiled with lime and water; it is then washed clean. 2. It is steeped for some hours in a solution of chloride of lime, or *bleaching powder*, as it is usually called. From this steep also it is washed clean. 3. It is boiled in a solution of American potash. After the duty *was* taken off common salt, carbonate of soda (and consequently caustic soda) *became* so cheap, that it gradually took the place

* I think it right to state, that for all my knowledge of Calico-Printing, I am indebted to my friend, Mr. Walter Crum, Calico-Printer, in the neighbourhood of Glasgow. With a liberality, for which I feel greatly indebted to him, he has explained his processes to me without mystery or reserve.

of pearl ashes.* 4. The cloth is now almost bleached; it requires only to be steeped in water holding in solution about four per cent. of sulphuric acid, to complete the process.

Cotton cloth at an average, takes about two days to bleach. But, when there happens to be occasion for greater dispatch, it is no uncommon thing to complete the bleaching and callendring in twenty-four hours.

PRINTING.—There are two modes of printing, namely, *block-printing* and *cylinder-printing*. The former has been practised from time immemorial; the latter is a modern invention, and originated, probably, after the introduction of the art of printing into Great Britain.

The *block* is a piece of sycamore, (or, more commonly, a fir board, on which a piece of sycamore is glued) on which, the pattern intended to be printed on the cloth is cut. The parts which are to make the impression, are left prominent, while the rest of the block is cut away; just as is practised for wood engravings. When the pattern is too complicated, and the lines too fine to be cut in wood, they are made by means of small pieces of copper, drawn out into narrow ribbons of the requisite fineness; these are ingeniously driven into the block, and the intervals are filled up with felt. Great patience and ingenuity are displayed in making these blocks for use, and calico-printers are under the necessity of keeping a number of workmen, at high wages, for that express purpose.

The inventors and drawers of the patterns, constitute another class of ingenious artists, in the pay of the calico-printers at high wages.

The *cylinder* is a large cylinder of copper, about a yard in length, and four or five inches in diameter, upon which the pattern to be printed on the cloth is engraved. This cylinder is made to revolve, and press against the cloth, taking up the mordants, or colours to be printed on the cloth as it revolves. By this ingenious contrivance, two or even three different colours, are printed on the cloth at once, and the printing proceeds, without interruption, till a whole piece, or indeed, any number of pieces attached to each other are printed.

Another method of printing is almost the same as copper plate printing. The patterns is engraved upon a flat copper plate, a yard or more square. Upon this plate, the colour or mordant to be applied, is spread. It is then pulled. As it passes along, an elastic steel plate, called a *doctor*, takes off all the colour, except that which feels the engraving. Being pressed against the cloth in the act of pulling, it prints upon it either in mordants or colours, as may be the impression of the pattern.

Whether the printing is applied by the block, the cylinder, or the flat plate, the treatment of the goods is nearly the same.

Most commonly, the printing process is employed to fix the mordants upon the cloth, which is afterwards dyed in the usual way. Those parts only retain the colour which have imbibed the mordant, while the other parts of the cloth remain white. Sometimes acids, or other substances, are printed on cloth already dyed, to remove the colour from certain portions of it which are to be left white, or to receive some other colour.

Occasionally, substances are printed on cloth before it is dipt in the indigo vat, to prevent the blue colour from becoming fixed on those parts to which they are applied. Substances possesed of these properties are called *resist pastes*.

It is a very common practice to communicate mordants and colouring matters to cloth at the same time.

We must give a sketch of the different substances thus applied, before proceeding to detail the different processes.

I. MORDANTS.—The term *mordant* is applied by dyers to certain substances with which the cloth is impregnated before it is dyed, otherwise the colour would not fix, but would disappear on washing or exposure to the light. The name was given by the French dyers (from the Latin word *mordere, to bite,*) from a notion entertained by them that the action of mordants was mechanical, that they were of a corrosive, or biting nature, and served merely to open the pores of the cloth, into which the colouring matter might insinuate itself. It is now understood that their action is chemical. They have an affinity to the cloth, which causes them to adhere to it; while the colouring matter has an affinity for, and adheres to, the mordant.

The usual mordants employed by the calico-printer, are the three following:—

1. *Alumina,* or the *alum mordant.* This mordant is made by dissolving alum in water, and adding acetate of lime to the solution. The liquid has a specific gravity of 1.08, and contains about as much alum undecomposed, as the liquid can hold in solution. For particular purposes, calico-printers make a mordant by mixing three parts of acetate of lead with four of alum. This mordant consists of a mixture of acetate of alumina and alum; for about a third part of the alum remains undecomposed.

When cloth is impregnated with this mordant, such is the affinity of the alumina for the cloth, that the acetate of alumina, and even a portion of the alum, are decomposed, and the particles of alumina adhere to the fibres of the cloth so firmly that they cannot be removed by washing.

In order to determine the quantity of alumina fixed on the cloth by the aluming process, I got a quantity of the cotton cloth that was to be dyed Turkey-red; 1000 grains of this cloth were burnt, and the ashes being reserved, and subjected to a chemical analysis, were found to contain 0.4 grain of alumina; 1000 grains of the same cloth after being dyed Turkey-red, and of course, impregnated with the alum mordant, were treated in the same way. The alumina obtained amounted to 8 grains. The length of a piece of this cloth,

† An impure Soda ash is now very generally used by bleachers. For, as every hundred pounds of crystallized carbonate of Soda contains 62½ of water, the expense of carriage is more than double, and although the form indicates in some measure the purity of this salt, every bleacher knows how to estimate the value of the drier preparation.

weighing 1000 grains, was 1 yard $5\frac{2}{3}$ inches, and its breadth 33 inches. Thus, a piece of cloth, amounting to 1386 square inches, or rather, 2772 square inches, (as both sides of the cloth had been equally subjected to an aluming process) had combined with 7·6 grains of alumina; or every square inch of the cloth had combined with 0·0027 grains ($\frac{1}{370}$th of a grain nearly) of alumina.

1000 grains of the same cloth were dyed the palest shade of Turkey-red usually given to cloth. When burnt. the ashes were found to contain 0.8 grain of alumina. Substracting the 0 4 grain of alumina belonging to the cotton fibres, there remains 0 4 grain for the quantity communicated during the aluming process. In this case, every square inch of surface of the cloth had combined with 0 00012 grain of alumina, or less than $\frac{1}{8000}$th of a grain. Yet this quantity of alumina small as it is, was essential to the permanence of the dye. For, when unalumed cloth was dyed with madder, the colour was easily washed out with water.

When cloth to be dyed red is impregnated with this mordant, it is not thickened. When applied only to particular parts of the cloth, by the block or cylinder, it is thickened with flour, or calcined starch, or gum senegal, according to the nature of the style of work.

2. OXIDE OF TIN.—Perchloride of tin is very much used as a mordant. The colouring matter is previously mixed with it, and both are applied at once. Such applications are usually called *chemical colours.** The mixture is allowed to dry on the cloth, which is then merely washed with water. When colours are applied in this way they are easily altered by soap, exposure to the light, &c. Hence, in common language, a *chemical colour* means a fugitive colour. The colours produced in this way, are *pink* from Brazil wood, peach wood, and cochineal; *purple* from logwood, and *yellow* from Persian berries.

Perchloride of tin is much used in another common process of calico-printing, known technically, by the apellation of *steam colours.* It is decomposed and converted into *stannate of potash.* The whole piece of cloth is immersed in the liquid containing the stannate of potash, and dried. The peroxide of tin is then deposited on the cloth, by immersing the piece in a solution of sal ammoniac, or sulphate of magnesia; but most commonly, in a very weak solution of sulphuric acid. The different colouring matters, previously thickened with starch, are then printed on the cloth, and the whole subjected to the action of steam. By the joint action of moisture and heat, a combination takes place between the colouring matter and the oxide, which is thus rendered insoluble. And no considerable quantity of water is ever present to carry off the colouring matter. before it has combined with the mordant.

3. PEROXIDE OF IRON.—This metallic oxide is much used as a mordant. It is employed in the state of acetated protoxide of iron, formed by dissolving iron in pyroligmic acid. Within a few days after it has been applied to the cloth, especially if exposed to a moist atmosphere, it loses its acid, and the iron becomes peroxidized.

Acetate of iron, of the specific gravity 1-05 gives a black, with madder. Various shades of *purple* are obtained by adding different portions of the mordant and dye-stuffs. Different shades of *red*, from brown, red to pink, are obtained in the same way, substituting the alum mordant of various strengths for the iron. *Chocolates* are got by mixing the aluminous and iron mordants, and then dyeing with madder.

Indigo, oxide of manganese, catechu, &c. are colours per se, and therefore, require no mordant.

(To be continued.)

ROYAL INSTITUTION.

FEBRUARY 27.

FLOOR CLOTH MANUFACTORY.—Mr. Brande gave a description of this manufacture, and added greatly to its interest by going through the various steps of the process, with the assistance of some workmen employed in the manufactory at Knightsbridge. The main part of the manipulation is similar to calico-printing, the figures on the blocks being upon a much larger scale, and the cloths which are printed being of an infinitely greater size. The common dimensions of a floor cloth are 210 or 220 square yards, and hence the immense size and often unseemly appearance of floor cloth works. A stout canvass is chosen in the first instance. This is nailed to one extremity of a wooden frame, and stretched by means of hooks which are attached to the other sides. It is then washed with a weak size and rubbed over with pumice stone. No other substance has yet been found which answers the purpose so well as this mineral. The next step is that of laying on the colour, which is performed by placing dabs of paint over the canvass with a brush, and then rubbing or polishing it with a long peculiar shaped trowel. Four coats of paint are thus applied in front and three on the back of the cloth. To remove it from the frame when these processes are finished, a roller on a carriage is employed, upon which it is rolled and conveyed to the extremity of the manufactory for the purpose of being printed.

It is then gradually transferred from the roller and passed over a table which is 30 feet long and 4 feet wide, made of planks placed vertically, and as it proceeds over the table, the blocks, dipped in the appropriate colours, are applied. The colours used are ochre, umber, vermilion, and different kinds of chrome, mixed up with lintseed oil and a little turpentine.

The number of blocks applied to one pattern depends upon the number of colours.

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* A very general error prevails with regard to chemical colours, that it is the mode of applying them which renders them fugitive. It is because chemical colours are made with changeable materials, that they are more easily acted on than madder colours. Brazil pink for instance, is equally acted upon by light and soap when dyed.

The first mode of applying the patterns was by stencils, that is, the pattern was cut out in paper, and when the paper thus prepared was applied to the cloth to be painted, that portion where the ground was exposed by the interstice in the paper was traversed by a brush. Then, a combination of stencilling and printing was had recourse to, the former process being first made use of, and then a block was applied, the stencilling forming the ground work. Stencilling is now abandoned In printing, it is necessary that the cloth should first be rubbed over with a brush, else the colours will not adhere. Whether the effect is electrical or not has not been ascertained. Every square yard of good oil cloth weighs 3½ or 4½ lbs. each gaining by the application of the paint 3 or 4 lbs. weight, and hence, the quality of this manufacture is judged of by the weight. Whiting is often used in spurious cloths, mixed with oil. Cloth prepared in this way speedily cracks and becomes useless.

Good cloth, with a very stout canvass, is used for covering verandahs, and will last nine or ten years, while spurious cloth will become useless in the course of one year. Floor cloth is employed to cover roofs, as at the manufactory at Knightsbridge, and for gutters. In the latter case it is remarkable that water remaining in contact with it produces no injurious effect.

Painted baize for tables is usually manufacture, with a smooth side, and is printed with blocks of a fine structure, resembling calico blocks. Fine canvass is employed; several coats of paint are laid on upon one side, and the other receives one coat, and is then strewed over with wool, or flocked, as it is called.

MANUFACTURE OF PENS.

BY DR. FARADAY.—Quills appear to have been employed, at least, as early as the seventh century. England is supplied with this article from Russia and Poland, where immense flocks of geese are fed for the sake of their quills. The quantity exported from St. Petersburg, varies from six to twenty-seven millions. Twenty millions were last year imported into England from these countries. We may form some idea of the number of geese which must be required to afford the supply, when we consider, that each wing produces about five good quills and that by proper management, a goose may afford twenty quills during the year. Hence, it is obvious, that the geese of Great Britain and Ireland, could afford but a very limited supply. The feathers of the geese of the latter countries are employed for making beds.

MODE OF PRESERVING MILK FOR LONG VOYAGES.

Sir,—As the season of the year is now arrived when hundreds of mechanics are induced to cross the Atlantic, in the hope bettering their fortune, and to those who may carry young families with them, milk may be an important article of diet, perhaps the following extract from an old newspaper of the date of 1822, setting forth a simple and easy method of preserving it, may be of importance; more particularly as I perceive from your last monthly list of new patents, that a method of preserving animal milk has just been patented—whether the same or a different method remains to be seen:—

"Provide a quantity of pint or quart bottles (new ones are perhaps best); they must be perfectly sweet and clean, and very dry before they are made use of. Instead of drawing the milk from the cow into the pail as usual, it is to be milked into the bottles. As soon as any of them are filled sufficiently they should be immediately well corked with the very best cork, in order to keep out the external air, and fastened tight with packthread or wire, as the corks in bottles which contain cider generally are. Then, on the bottom of an iron or copper boiler. spread a little straw; on that lay a row of the bottles filled with milk, with some straw between each to prevent them from breaking, and so on alternately until the boiler has a sufficient quantity in; then fill it up with cold water. Heat the water gradually until it begins to boil, and as soon as that is perceivable draw the fire. The bottles must remain undisturbed in the boiler until they are quite cool. Then take them out, and afterwards pack them in hampers, either with straw or saw dust, and stow them in the coolest part of the ship. Milk preserved in this way has been taken to the West Indies and back, and at the end of that time was as sweet as when first drawn from the cow."

I am, Sir, yours,
J. ELLIOTT.

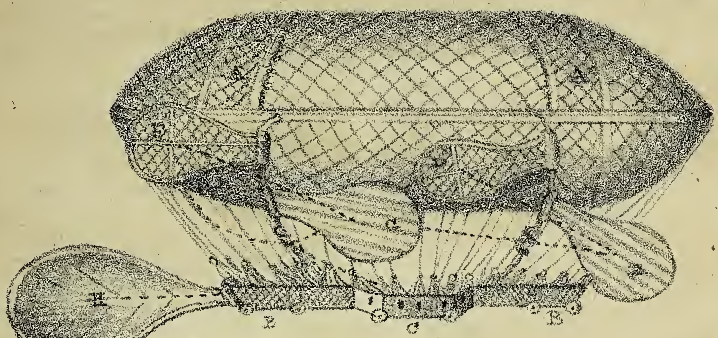
March 30, 1835.

ARTESIAN WELLS EMPLOYED TO ACTUATE MACHINERY.

At Fontes, near Aire, the waters of ten Artesian wells (springs obtained by boring, and so called from the province of Artois, in France. where his method came first into extensive use) put in motion the wheels of a large mill, and act besides on the bellows and forge-hammer of a nail-manufactory. At Tours, a well, of nearly 150 yards in depth, pours 225 gallons per minute into the troughs of a wheel seven yards in diameter, which is the moving power of an extensive silk manufactory.—*M, Arago, Annuaire,* 1835.

CALCULATING MACHINE.

A gentleman, who is known to us, and for whose scientific ingenuity we can readily vouch, has requested us to state, that he will engage to furnish for a sum of not more than 40*l*. a calculating-machine, having three orders of differences, of five, four, and three places of figures respectively, and capable of calculating any table whatever of six places of figures, with the third difference constant. He will ask no money till the machine is delivered perfect acco ding to the above objections: and would not object to bearing himself half the expense, on condition of retaining a corresponding interest in the machine.—*Mechanics' Magazine,* 1835.



THE FIRST AËRIAL SHIP, "THE EAGLE."

Sir,—Herewith I send you a rough pen-and-ink sketch of the "Eagle," which is at present the *Lion* of the day. The monster-machine is the production of some individuals who last year formed themselves into a Society at Paris, and proposed opening an aërial communication between that capital and London. After having instituted several experiments, these parties felt so confident of the practicability of their undertaking, that they actually fixed the time at which they would make their first voyage. Upon the appointed day, all Paris flocked to the starting-place, to witness the departure of the intrepid aëronauts; but the eager expectations of this assembled multitude, and the confident hopes of the projectors, were equally disappointed, for, in consequence of the balloon being overcharged with gas, it suddenly burst with a loud report, just as it was on the point of leaving *terra firmâ*.

These individuals, under the style and title of "The European Aëronautical Society," with Count Lenox for their President, have lately located themselves in the Victoria-road, opposite the avenue leading to Kensington Palace, where the following announcement may be seen:—

"EUROPEAN AERONAUTICAL SOCIETY.—*First Aërial Ship*, the "Eagle," 160 feet long, 50 feet high, and 40 feet wide, mounted by a crew of 17 persons, and constructed for establishing a direct line of communication between the several capitals of Europe. The first experiment of this new system of aëreal navigation will be made from London to Paris, and back again."

In the accompanying sketch, A A is the balloon or gas-holder, composed of 2,400 yards of cotton lawn, thoroughly varnished to make it air-tight; it is in the form of a cylinder, terminating at each end in a cone, and is said to contain about 7,000 cubic feet of gas.

The car, or packet-boat as it is termed, B B, is 75 feet long, and 7 feet high; the frame-work is of wood, with strong netting all round it to prevent any of the crew or passengers from falling out. C is a cabin in the centre of the car, 6 feet wide. D E F G are four wings, by which the vessel is to be propelled; each wing is formed of 80 moveable flaps of varnished lawn, 2 feet 6 inches long and 9 inches wide, strained upon a frame-work of cane. There is a strong netting on one side of the wings to support the flaps whilst striking the air and propelling the vessel. D and F show the net-work; E and G, the flaps. The mechanism for working the wings is placed inside of the cabin. C H is a rudder at the end of the car, by which the inventors expect to be enabled to steer the vessel through the trackless fields of air at pleasure.

The Society have announced their intention of making their first voyage some time in August; in the interim, this Leviathan of the upper regions is exhibiting in the "dock-yard" at one shilling each person.

The *Morning Herald* observes of this machine:—"A more unwieldy and ungraceful entity never moved on or in any element. The whale and elephant are beaten *hollow* by it in point of form and grace; yet, like one and the other, it may be able to make more rapid way than man or horse." The projectors have displayed considerable ingenuity in many of their arrangements, and may eventually succeed in rendering balloons more manageable than they have hitherto been; but I think the Society would have shown more judgment by continuing their experiments, and establishing the correctness of their theory on a more moderate scale; they would then possibly have proceeded with somewhat less *éclat*, but with greater probability of success.

The form of the baloon will cause it to lie in the direction of the wind. If the current of wind is only slightly contrary to the desired course, and the propellers can be made to act, there is little doubt, the rudder H will enable the voyagers to keep their path. If the wind proves very contrary—and it is well known that the atmospheric currents are frequent and fitful—then the voyagers have no alternative but to descend a little, by which means an unfavorable may often be changed for a favourable current. To effect partial descent when necessary, atmospheric air is forced into a small balloon inside of the large one, similar to the air bladder in fishes; this can be filled or exhausted at pleasure by very simple means.

If this small balloon is filled with atmospheric air, the gas in the large one will be compressed to such a degree, that, with the load in the car, the whole machine will be rendered specifically heavier than the atmosphere, and descend accordingly. On reaching a more favourable current, the crew withdraw the air from the small baloon, and the gas expanding restores a due proportion of the original buoyancy to the machine.

This method may answer the purpose, but it appears to me that there is great risk of bursting the baloon, by compressing the gas to such a degree as to effect efficient reduction of the boyancy. A much better plan was proposed by Mr. G. C. Atkinson, of Newcastle-on-Tyne (in your 10th volume) viz. to withdraw a sufficient quantity of gas from the baloon by condensing it into a suitable copper vessel, and restoring it again to the balloon as required.

With respect to the mode of propulsion adopted by the inventors of the "Eagle," I may just state, that I do not consider it by any means the best that could be employed. I remember hearing a lecture on aërostation delivered by Mr. Tatum, some years since, in which he proposed to effect aërial navigation by means of two revolving vanes and a rudder. A very considerable velocity could be imparted to a pair of vanes, without so great a loss of power as must necessarily take place in using wings.

Balloons have for a long time past been mere toys, exhibited for the sake of gain; and, I confess, I am glad to see aërostation, as a science, is not entirely forgotten. There is, doubtless, but a very limited sphere of usefulness open to balloons; but, I believe, much more can be accomplished than many persons are at present prepared to admit. I may return to this subject again by-and-bye. In the mean time.

I remain, yours respectfully,

Wm. Baddelley.

London, July 6, 1835.

MARTIN'S ARITHMETICAL FRAMES.

The powers of numbers, and their relation to each other, have been in a variety of ways demonstrated; but rarely indeed with any important practical application: we have ingenious theories of the wondrous powers of the number 9, and a variety of arithmetical legerdemain is abroad, which appears to the curious very singular and astonishing. Napier's bones or rods afford some good illustrations of the multiplying powers; but there appears to have been no instance of the successful application of the "occult powers of numbers" till the invention of the "Arithmetical Frames," by Mr. Martin, which are, without question, applied to a use the most important and extensive. But when we come to make an examination of these, we are unable to ascertain, except in one or two cases, the principles upon which they are constructed. In these frames we have what is most extraordinary, a system of arrangement which carries out, *ad infinitum*, practical exhibitions of all the elementary rules, not singly only, but also in every variety of combination which the ten digits will make, affording demonstrable proofs of the correctness or incorrectness of every figure; at the same time that none but the teacher who has been previously informed of the mode of detecting error, can by any possibility be informed of it. A dozen exercises of fifteen or sixteen figures each, may be worked in *one* rule only, or through the whole *four* rules, and be checked by the master at a mere glance, while those exercises may be varied to the extent of many thousands of millions times, and be proved by the same mode and with the same facility. It has often occurred to mathematicians, that a series of numbers might by some possibility be arranged, so as to produce uniform and known results in an almost infinite series; but this suspected power of the arrangement of numbers has never been shown, excepting in a few cases of particular numbers; and even these have not been applied to any practical purpose, excepting by Patrick Whytock.* But this arrangement, which is founded on the peculiar properties of certain decimal fractions is defective, as it only refers to the simple rules, whereas the arithmetical frames or tablets constructed by Mr. Martin, comprise also the *compound rules*; and this appears most extraordinary; for there cannot well be worse decimal relations, supposing they are constructed on this principle, than those of the numbers 4, 12, and 20, which form the integral parts of our common currency; but Mr. Martin has arranged and can apply, if necessary, his principle through all the *weights and measures*, affording an infinite variety of examples, whose solutions bear such a relation to their propositions, that their correctness or incorrectness is immediately discoverable by him who has learnt the mode of discovery; and which may be acquired, by any one conversent with addition and multiplication, in a few minutes. Nor is this all, for the frames are so arranged that the smallest as well as the largest examples may be given; that the working of the examples, of one rule gives examples in another, and the working again of these examples in a third, and so on—proving the correctness of each, even to the pupils themselves, and pointing out

* See Mech. Mag., vol. xviii p. 43.

error ; at the same time that the master has a counter check, which he can apply in a moment to a whole morning's set of exercises. Such a plan, where a large number of boys are to be taught, as in National and Lancastarian schools, must be of incalculable advantage ; and even in private schools must afford great assistance to teachers, from the variety of examples presented, and the ease with which their answers may be ascertained.

Discription of the Frames.

The " Arithmetical Frames" consist of six frames, about 18 inches high and 1 foot broad. The first of which is fitted up with little balls transverselv arranged on four brass rods, as the ball frame of the infant schools ; but to this, which only forms the top part of the frame, nine cubical rods vertically placed, and rovolving of pivots, are attached : on one side of these rods are small pictures about an inch square, of ships, horses, cats, cows, and such like figures differently coloured ; their object is, as is also of the balls, to teach the *infant* to count, and to connect abstract signs with tangible objects. The other three sides of the rollers are filled up with three numeration tables, so ingeniously disposed, that by the turning of the rods, every variety of change of figure may be produced so strikingly, that a few hours are generally sufficient to teach a child the principles of numeration and notation with the rudiments of addition.

The succeeding frames comprise a frame for each of the following rules ; the addition frame consists of 12 cubical rods, *horizontally* placed, and by the simple turning of these, an infinite number of examples may be produced, and their answers discovered in a moment. To the subtraction frames, which are constructed to hold only two rollers at a time, containing the subtractors, and the subtrahend, large slates are also attached, on which the remainders are worked, one below the other, forming an example in addition, which is added up. The multiplication and the division frames are made to contain only one roller, the former has a slide upon which the multipliers are printed, which shows one figure at a time through a square hole immediately under the unit of the multiplicand, and the latter has a slide for the divisors moving up and down the dividends to change the examples ; by which simple contrivance, as many changes may be produced as upon a peal of 12 bells stated to be several thousands of millions. In these two latter frames there is still a recapitulation of preceding rules with different examples applied throughout the compound as well as through the simple rules;—the whole forming a system of teaching the theory of arithmetic so complete, as to make improvements extremely difficult, and presenting a combination of figures whose results are, as we have stated, " most extraordinary in the history of the relations of number ;"—and their effects on the children who are taught by them, as is exemplified at the Borough-Road Central Schools ; to use the words of Lord Brougham, in his speech on Education—" present the most extraordinary spectacle of the progress of obtaining information which might be made by childern, and which he had never seen or heard of at any place, in any country, or at any time. It was perfectly wonderful how the human faculty could, at so early an age, be cultivated to so marvellous a degree. A dozen or two of the children were asked such questions as the interest of various sums of money for any time, at any rate per cent., and their answers were as correct as they were immediate." His Lordship repeated, that " he had never witnessed a more extraordinary exhibition."—*Educational Magazine.*

MR. BABBAGE AND HIS RIVALS.

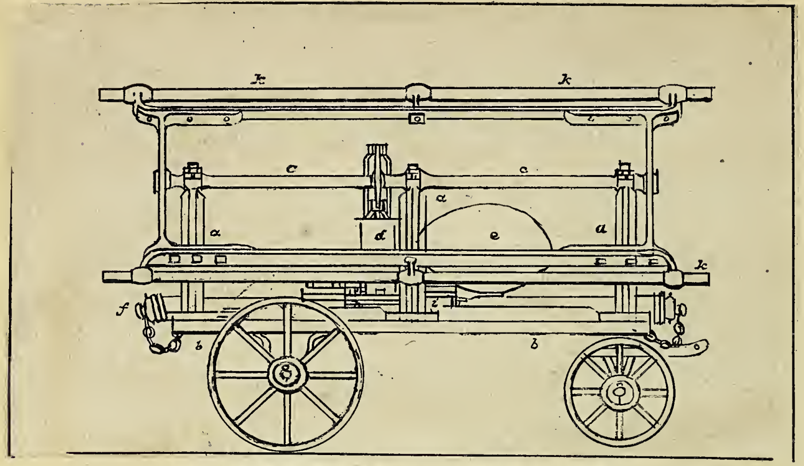
Sir,—In a late number of your publication, I observed that one of your correspondents claims to be the inventor of a calculating engine which will perform the operations of Multiplication, Division, and even do sums in the Rule of Three. As this is a subject in which I take a considerable interest, I hope I shall be excused if I request a little more information ; and first I wish to learn whether this is a self-acting machine, that is, supposing that two numbers are to be multiplied together, is it merely necessary to put them into their proper places, and having adjusted the machine to multiply, to turn the handle until it shall give some signal that the operation is completed ? Or when one number is put in as a multiplicand, is it necessary to turn the handle as many times as the number indicated of the multiplier ? The question applies equally to Division, and to the Rule of Three, which is a combination of the other two. Also, can it be applied to calculated tables, and if so, how are its results indicated ? A machine which when once adjusted to perform an operation requires an assistance from the mind (even the common operation of counting the number of turns of the handle to know when to expect the result) is open to the objection of liability to error. If one turn be omitted, an error is induced into the calculation, and an error made by a machine is the more dangerous because unsuspected. I understand that Mr. Babbage's calculating engine is not liable to these objections, and that one great merit is, that its results are the operation of the machine itself, and engraved upon copper plate with unerring certainty. Has the inventor of this new machine taken any steps to make it public, or secure the patronage of Government ? Matters of this kind are of great public interest, and many valuable inventions perish for want of early attention. I trust, therefore, you will excuse my troubling you on the subject.

I remain, very truly yours,

P. S. C.

INDIAN-RUBBER BOAT.

The *Providence Journal* gives a description of the Indian-rubber boat—a neat affair, weighing abbout 20 lbs., which may be folded up and carried about from place to place. It will sustain a ton weight, and accommodate quite a fishing party !



TILLEY'S NEW METALIC FIRE-ENGINE.

Sir,—After witnessing the introduction of boats, bridges, and churches of cast-iron, with many other extraordinary applications of this highly-useful material, your readers will not be much surprised at the introduction of cast-iron fire-engines, and this material enters pretty largely into the machine I am about to describe.

It is well known that hot climates exercise a most injurious effect upon all things constructed of wood, especially if occasional moisture assists the operation of the heat. Among other machines which manifest the existence of this destructive influence, fire-engines are particularly liable to dilapidation : sometimes satured with water, and then exposed to parching dryness—laid by unheeded until required for use—no wonder they are so often found unserviceable. To obviate the serious inconvenience arising from this cause, and to render the fire engine, as far as possible, proof against the effects of climate, Mr. W. J. Tilley, engine-maker, Blackfriars-road, London, has constructed a fire-engine entirely of metal, of which fig. 1 is a side, and fig. 2 an end-view. The same letters of reference apply to both drawings.

a a a are three cast iron standards, fixed upon a quadrangular floor or framework *b b*, of the same material. *c c* is the main axis working in brass bushes on the tops of *a a*. *d d* are the two brass cylinders or pumps, *e* is the air-vessel, of copper ; *f* is the suction-pipe ; and *g* the delivery pipe. A chamber *h* contains the suction-valves, the delivery-valves being placed in a similar chamber *i* in front of the cylinders. *k k* are the handles, made of sheet-iron rolled up, which, by means of the cross-levers, impart alternate motions to the pistons.

The pistons are attached by slings to a projecting-arm on the axis *c*, the parallelism of the pistons being preserved by guide-rods in the usual manner. *l* is the fore-carriage.

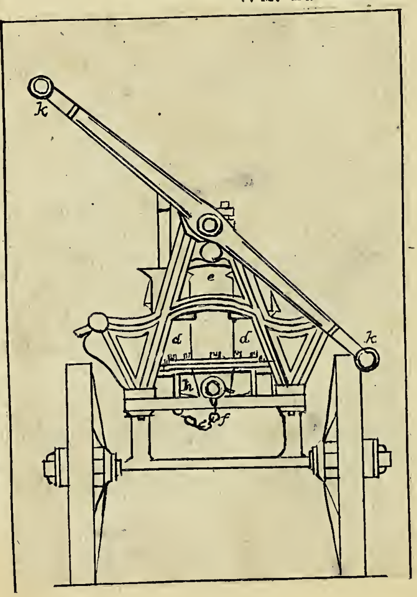
The whole is mounted on four cast iron wheels, and has rather a light and elegant appearance.

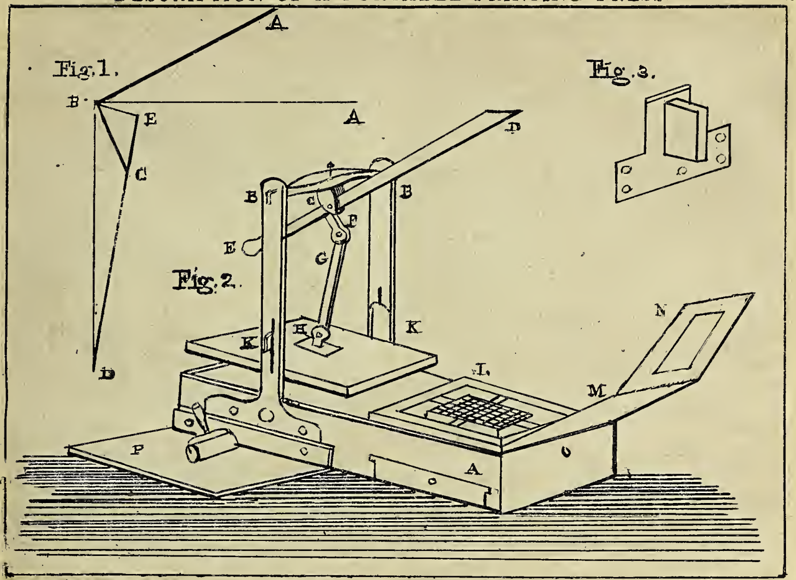
In the construction of his engine not a particle of wood is employed ; the valves, the pistons, and, in fact, every part is of metal.

This engine exhibits, in a very pleasing manner, the situation of all the working parts which, in fire engines of the ordinary kind, are enclosed from view ; but a most important advantage consists in the facility with which any little derangement in the machine can be seen and remedied. The valves, which are almost the only parts liable to get out of order can be got at immediately, as it is only necessary to unscrew and remove the cover of the valve-chambers, to examine and repair any obstruction in this part of the machine.

The durability of this description of fire-engine, and its fitness for all foreign stations, especially in hot climates, must be so great, that for such services I have no doubt they will in time supersede all other engines constructed of so perishable and uncertain a material as wood.

I remain, Sir,
Yours respectfully,
Wm. Baddeley.





SIR,—Having been led by circumstances to attempt the construction of a printing-press, which should combine the properties of simplicity, cheapness, and portability; and having succeeded therein to the utmost extent of my expectations, the following description may perhaps not be unacceptable to your readers. I shall first explain the principle I have employed, and then describe the construction by which I have endeavoured to adapt that principle to the purpose required.

A B C, fig. 1, is a lever, bent into a right angle at B, at which point it moves on an axis as a fulcrum. To the extremity, C, a piece C D is united by a joint at C, and the lower end of which, D, is confined to move in the straight line B D. Now, if any power, as the hand, be applied at A, so as to bring B A into the position B A′ (B A′ being drawn at right angles to B D), it is plain, that the effect will be to bring B C and C D into the same straight line, and, consequently, to depress D.

To calculate the relation that subsists between the power applied at A and the ultimate force exerted at D, produce D C to E, and let fall B E perpendicular thereto. Now, calling the forces at A, C, and D, P, P′, and W, respectively, we have,

$$P : P' :: B E : B A \ldots\ldots\ldots (1)$$

$$\text{and } P' : W :: B D : D E$$

Or, substituting in the second analogy the equivalent of the ratio, B D : D E,

$$P' : W :: \text{rad} : \cos B D C \ldots\ldots\ldots\ldots (2)$$

Wherefore, compounding (1) and (2), and calling rad = 1,

$$P : W :: B E : B A \cdot \cos B D C \ldots\ldots\ldots\ldots (3)$$

Now, by trigonometry, $B E = B C \cdot \sin B C E = B C \cdot \sin (B D C + C B D)$ $= B C (\sin B D C \cdot \cos C B D + \cos B D C \cdot \sin C B D)$.

Hence, substituting in (3),

$$P : W :: B C (\sin B D C \cdot \cos C B D + \cos B D C \cdot \sin C B D) : B A \cdot \cos B D C.$$

And dividing by $B C \cdot \cos B D C$,

$$P : W :: (\tan B D C \cdot \cos C B D + \sin C B D) : \frac{B A}{B C}$$

$$\text{Or, } P : W :: (\tan B D C + \tan C B D) \cos C B D : \frac{B A}{B C}$$

$$\text{Finally, } P : W :: \frac{B C}{B A} :: \frac{1}{(\tan B D C + \tan C B D) \cos C B D} \cdot\cdot (4)$$

We see hence, that P being constant, W varies as a function of the angles C B D, B D C, viz. as, $\frac{1}{(\tan B D C + \tan C B D) \cos C B D}$.

Let us examine, therefore, what change takes place in this expression in consequence of a diminution of the angle A B A′ by B A being depressed. We observe, then, that the denominator consists of two factors, of which the first (being the sum of the tangents of two angles, each of which is less than a right angle), decreases without limit, and becomes$=$O when B A coincides with B A′. The remaining factor, on the other hand, increases with the diminution of the angle A B A′; but its increase is limited by unity, which value it reaches when A B A′ vanishes. Therefore, the value to which the expression approximates as A B A′ decreases, is $\frac{1}{0}$, or $\sim$; and, consequently, the ratio of P : W continually approximates to that of $\frac{\text{B C}}{\text{B A}} : \sim$, that is, the power applied at A, exerts at D, by the diminution of the angle A B A′, a continually increasing force ; and this increase is without limit, for by sufficiently diminishing this angle, the force at D may be made greater than any that can be assigned.

We have here, however, made no allowance for friction, and the imperfect rigidity of the materials employed ; and it is found in practice that these causes set bounds to the increased referred to long ere the attainment of such a force as that just mentioned. The latter of these causes, moreover, renders the exertion of some degree of power necessary to release the lever B A from its position after the pressure has been given. It is, therefore, found expedient not to reduce the angle A B A. below a value of from 3° to 5° ; and to seek any further degree of force that may be necessary by other means. An examination of the formula in (4) shows that this is to be done either by increasing P or by diminishing the ratio of B C to B A and C D.

It is considered a desideratum in all modern printing-presses that the same power shall exert a continually increasing force ;* and as we have seen that the principle demonstrated above furnishes us with such a force, it is evident, that if we can apply it properly it is suitable for our purpose. I proceed, therefore, to describe the press I have constructed, premising, that it is on a very small scale (just sufficient to print an octavo page), yet large enough to test the accuracy of the principle.

A, fig. 2, is a strong frame of wood, 21 inches long, 9 broad, and 4 deep, to which are attached, by means of screws, and a bolt which goes completely through the frame, and is fastented with a nut on the opposite side, the two cheeks B B. These cheeks are of wrought-iron, $1\frac{1}{2}$ inches broad, and $\frac{5}{8}$ths thick. They are connected at top by a strong iron bar, the ends of which are fixed into mortices in the cheeks. This bar is at the ends about the same breadth and thickness as the checks, but increases in thickness towards the middle for the purpose of allowing to be rivetted to it two pieces, C, between which, upon an axis passing through them, the lever D E moves. Another object served by the thickening of the connecting bar is to allow of the insertion of a screw Q, of which the part that projects under the bar, and with which the prolongation of the lever D C comes in contact, by being lengthened or shortened has the effect of regulating the pressure to be given, according to the nature of the *matter*. An iron plate is screwed to the under surface of the lever D E, to which the piece F, also of iron, 1 inch broad and $\frac{3}{8}$ths thick, is rivetted. To the lower extremity of the piece F a bar G, $\frac{5}{8}$ths of an inch broad and $\frac{1}{4}$th thick, is attached by a rule-joint. G is united at the other end by a similar joint to a plate H, which is screwed to the top of the platten The lengths of F and G, reckoning from the centres of motion, are $1\frac{1}{2}$ and $3\frac{1}{2}$ inches, respectively. The platten is of wood, $1\frac{1}{2}$ inch thick, having screwed to its under surface a plate of cast-iron, ground very flat ; and is preserved in its position, and confined to move parallel to itself, by guides K K, which pass through grooves in the cheeks, having just room enough to move freely without shake. These guides are of the form shown in fig. 3 ; and it is necessary to observe in regard to them, that the parts which pass through the cheeks must be so adjusted as to height, that a line drawn through the centre of motion at H, parrallel to the surface of the platten, shall pass through a point in each, equally distant from the top and bottom. If this be neglected, these parts will be strained and liable to be twisted. L is a box, 10 inches long and $8\frac{1}{2}$ broad, which answers the purposes of *chase* and *carriage*. The sides are 1 inch thick ; such a degree of strength as is thus acquired being necessary to resist the pressure created in *locking up* the *matter*. Its depth is adjusted to *type height ;* and the bottom is about half an inch thick. It slides upon the frame A, being confined by a rim, about half an inch high, which goes round

* The reason of this is, that in order to afford room for the necessary motions and adjustments, the platten requires to move through a considerable space. This condition cannot be fulfilled by any ordinary combination of levers (or any other of the mechanical powers) without, at same time, making it needful for the motive-power to pass through a space inconveniently great. Now, by such an arrangement as the above, in which the advantage gained is least when the platten meets with no resistance to its descent, and reaches its maximum only when the platten comes in contact with the face of the types, a greater space is on the whole described by the platten than would be the case were the force uniform throughout, and equal to that which is required to produce an impression.

the latter; and it is drawn from under the platten by a small knob, represented at O M is the *tympan*, and N the *frisket*, attached to the box in the usual manner. P is the *inking-table*, composed of a plate of cast-iron, imbedded in a frame of wood. It is fixed to the frame A by two thumb-screws. When not in use these screws are withdrawn, and the table turned round and pushed into a groove fitted to receive it, where it is again secured by the same screws. At A is a drawer for holding *furniture*, &c. At E is a weight to raise the platten after the pressure has been given, and keep it suspended. The part D C, of the lever D E, should be of such a length, as, when brought into a horizontal position, not to extend beyond the end of the frame A; otherwise, when a heavy pressure is applied at D, the whole will be liable to be overturned. In the present case, D C is 16 inches long. The height of the cheeks B B should be such that the requisite pressure may be given a little before D E comes into a horizontal position. Any small error in this respect may be rectified by either planing down, or pasting folds of paper upon the bottom of the box L.

It will be observed, that the object gained by the employment of a lever, in the position described above, for working the press, is portability, as in any other position of the lever the press would require to be fixed.

The mode of operation of this press will now, I believe, be tolerably clear; yet, to prevent misconception, I shall endeavour briefly to describe it. We shall suppose the *matter locked up* in the *chase*, or box, L, and the *inking-table* secured in its proper situation for working. The first thing to be done is, to put a little ink upon the table. Having distributed this equally with the roller, the workman lifts the *tympan* and *frisket*, and passes the roller over the face of the types in the usual manner. A piece of paper is then put upon the *tympan*, and this, together with the *frisket*, turned down upon the types. The box is now pushed under the platten, and the lever pulled down till brought to a stop by the screw A. The lever is again raised, and the box withdrawn by the knob O. This process is to be repeated till the number of impressions required are obtained.

Resuming the expression (4), and fig. 1, we find the following value of W,

$$W = P \times \frac{BA}{BC} \times \frac{1}{(\tan BDC + \tan CBD)\cos CBD.}$$

Now, here $\frac{BA}{BC} = \frac{16}{1\frac{1}{2}} = \frac{32}{3} = 10\cdot66$, and we may assume for P what we please. The last factor, therefore, is the only variable one, and its variation depends solely on that of the angle C B D, or A B A, the other angle, B D C, being a function of this, and of the sides, B C, C D, which are given, and equal to $1\frac{1}{2}$ and $3\frac{1}{2}$ respectively. If, therefore, we wish to know the actual power of this press, and also the increase of power consequent upon a diminution of the angle A B A′ or C B D, we shall have to substitute in the above expression the values of P and $\frac{BA}{BC}$ for these quantities, and likewise to give successive value to C B D. The results will be the values of W, or the power exerted by the press, for each particular value of the angle CBD; and the differences of these results will be the increase corresponding to each diminution of that angle respectively. However, as W varies, *for the same value of* C B D, directly as P, it is evident, that if we call P, 1 pound, we shall be able, simply by multiplying the value of W, obtained on that supposition by any number assumed for P, to find the value of W corresponding to that value of P. Calling P 1 pound, then, and substituting for $\frac{BA}{BC}$ its value, the expression becomes,

$$W = \frac{10\cdot66}{(\tan BDC + \tan CBD)\cos CBD.}$$

The following table exhibits, in the first column, a few assumed values of the angle C B D, decreasing by 5°, except in the last case, where the decrease is only 2°; in the second, the value of W corresponding to these values of C B D, when P = 1 pound; and in the third, the increase of the power per cent., consequent upon each diminution of the aforesaid angle.

Values of C B D	Values of W. in Pounds.	Increase Per Cent.
25°	18·03	
20°	22·14	22· 8
15°	29·07	31· 3
10°	42·16	45·03
5°	85·61	103· 3
3°	226·18	164· 2
&c.	&c.	&c.

We here see that while when, C B D is 25°, a diminution of 5° occasions in an increase in the value of W of 22·8 per cent.; a diminution of only 2°, when C B D is 5°, occasions an increase in that value of no less than 164.2 per cent. Also, if we desire to know the absolute power of the press when

P is, say 20 pounds, and the angle C B D, 3°, we find $226{\cdot}18 \times 20 = 4523{\cdot}6$ pounds.

There are, as has been already stated, certain deductions to be made from the results in the second column, on account of friction and the imperfect rigidity of materials; and these deductions increase as we diminish the angle C B D. Since, however, they may be indefinitely reduced by careful construction, it is unnecessary to calculate them, if indeed that were possible.

I have said that the performance of his press answers my expectations; I send you some specimens, that you may judge for yourself.

I am, Sir,
Your obedient servant,
Q.

Aberdeen, July 10, 1835.

[The "specimen"s which our ingenious correspondent has been so good as to send us of his press, do it great credit. *We* have seldom the good fortune to see such *proofs*. There is one—a portrait in wood of Erasmus while reading—which is particularly good.—Ed. M. M.]

CALCULATING MACHINE - ANOTHER RIVAL TO MR. BABBAGE.

Sir,— Having seen some notices in the public papers of calculating machines invented at home aad abroad, I think it right to state that I have myself invented one, which is exceedingly simple, and might be made at the same expense as a common clock or time-piece. I can find the 10 power of the 9 digits in about twenty minutes; in fact, Addition, Subtraction, Multiplication, Division, the Rule of Three, Involution, Evolution, and a few other rules, may be worked with despatch and facility. The parts of my machine do not require such a critical adaptation, nor are they so liable to get out of order, as those of Mr. Babbage's machine; they may be made by any ingenious mechanic, and worked by any wayfaring man, though a fool.

I remain Sir, your humble servant,
J. S. Holland.

Three, Colt-Street, Limehouse.

The Bude Light is a name given by Mr. Gurney (of steam-carriage abortion celebrity) to a new light which he has discovered, and so named, after his new place of residence in Cornwall. It is obtained by directing a stream of oxy hydrogen gas on a quantity of pounded egg-shells. The light is represented to be 140 times greater than any of those now employed in lighthouses—so intense, indeed, that Mr. G. lately stated to the House of Commons Committee on Lighthouses, "his *belief* that it would he possible to make his light, by certain management, point out the precise situation of a coast beacon to a ship three or four miles at sea, under circumstances of a fog so dense that no other light—not even that of the sun—could penetrate it to any distance!

COOKING BY GAS.

Sir,—If any of your long list of readers are smitten with the desire of diffusing useful knowledge, and are in possession of the information I seek, they will thank me for affording them an opportunity of indulging that laudable and fashionable propensity. A gas-work has been lately erected in the town, and we are trying to make the heat given out in its combustion available for culinary purposes, or, in humbler phrase, to make it boil pots and kettles. We have tried the effect of an apparatus recommended in the fifteenth volume of your Magazine, page 344, and find it answer tolerably well. It consists of nothing more than a cylinder of thin sheet iron, twelve inches high, six inches wide at the bottom, and three at the top; the bottom is open, and the top is covered with a piece of fine wire gauze (forty-six threads in the inch), bound tightly over it by a brass ring. The gas pipe being carried two inches up the cylinder, the gas gets mixed with common air in it, and they ascend together through the gauze, and are set fire to at the top. The result of many experiments made with this machine, and with a larger one of a similar nature (but five inches in diameter at the top) seems to be, that two quarts of water, in a common copper tea-kettle, will be boiled, by the application of three feet of gas, whether burnt at the rate of ten or of twenty feet in the hour. Now, as our price is 12s. 6d. a thousand feet, the expense is only a half penny, and therefore we may be said to be already in possession of the valuable secret of making the pot boil. But, if any of your readers, as I said before, can put us up to a better plan, we shall be much obliged to them.

I am, &c.
M. P.

Hitchin, May, 7, 1835.

P. S.—I may add, that our gas is of remarkable purity and brilliance, and pleases all eyes, without offending any nose. The works were built by Mr. West, of Durham, under the superintendence of Mr. Lowe.—*Mech. Mag.*

HOWARD'S VAPOUR-ENGINE.

The Nautilus has arrived at Falmouth with latters from Lisbon of the 11th. The Comet, which had left Lisbon on the 8th, was obliged to put back with her machinery out of order. The plates immediately in contact with the heated quicksilver had burst, and rendered her manageable. The new invention has therefore, so far failed; but it is to have another trial.—*Times.*

ENGLISH SILVER ORE.

There was sold last week, at the Bank of England, the largest mass of English silver ever received into that establishment. Its weight was 5741 oz., and its value upwards of 1,5000*l.* It was the produce af a mine in the eastern part of Cornwall, at which ores containing from 500 to 1000 oz. per ton of ore not unfrequently raised.

No. 2. 1836
May.

REVIEW
OF WORKS ON SCIENCE
AND
JOURNAL OF FOREIGN SCIENCE AND THE ARTS.
EMBRACING
MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS, &c.

REVIEW.

THE JOURNAL OF THE ASIATIC SOCIETY OF BENGAL, EDITED BY JAS. PRINSEP, ESQ. F. R. S. SEC. AS. SOC. HON. MEM. AS. SOC. PARIS, COR. MEM. ZOOL. SOC. LONDON AND OF THE ROYAL SOC. MARSEILLES. VOL. IV. JANUARY TO DEC. 1835. CALCUTTA BAPT. MISSION PRESS, 1835.

Although upon the first publication of our Journal, it professed to embrace subjects purely medical, we have yet, from time to time, been led to the introduction of other scientific matter, which may in the opinion we fear of some of our contemporaries be deviating from the original intention of the work, inasmuch as it was not in connection with the simple acquisition of medical intelligence. This was, in fact, but experimental. We felt sure that general science could not be without interest to men whose peculiar education had afforded them decided advantages for the prosecution of scientific studies; while we hoped that the intrinsic value of our Journal would not be lessened in their opinion, by becoming the channel of instruction, as well as of amusement, to all. There can be no just reason why a work which commences on one specific subject, should not be extended to others, provided it can be shewn that any good is likely to ensue from the extension. In this consideration we increased its pages by inserting extracts from works of Scientific repute, and have found—what we looked to find—the encouraging result of an increasing subscription list, without the withdrawal of support for having so ventured to wander from what would have been strictly speaking, the more proper and immediate objects of the India Journal of Medical Science.

To guard against further misconception the Medical Journal, as must now be perceived, is wholly distinct. The advantage of combining the Journal of Foreign Science with it is, that in their present united form, they are got up at a less expence than they would be were they supplied seperately, and we are enabled from the peculiar Regulations of the Post Office to send both to our subscribers free of additional post office charges.

The perusal of a periodical merely professional, could afford but a meagre and very limited interest. But in allotting a space for other matter, we have the prospect of combining knowledge and recreation; and while we endeavour to spread out a repast adapted to all astes, we reckon on the indulgence and good feeling of our Brethren whom we would serve with our best ability, for granting us a continuance of their suffrages in the performance.

Having thus explained our intentions, we shall now reduce our professions to practice, and commence our review with a notice of the Asiatic Journal for the past year. This work is published in nos. monthly, and edited by Mr. Jas. Prinsep, a gentleman eminently qualified to maintain its celebrity and sustain its pretensions, side by side, with the literary productions of Europe, where amongst the learned, it has long passed current, and been received as standard. It touches upon all subjects of Indian research, embracing history, geology, statistics, religion, literature, geography, numismatics, &c. and opens to us a vast range of investigation on every one of these points. Before entering, however, on a critical examination of the contents, which from the limited space we can afford, must necessarily be continued from No. to No.,—we shall pause to remark upon the conduct of Government, in withholding its patronage, its fund, and support from the Society,

for the exclusive purpose of European education, to the manifest detriment, if not the ruin, of oriental literature. In the month of April, it appears, from the proceedings of the Society, that the Secretary (Mr. J. Prinsep) submitted to it the necessity of a respectful remonstrance against the Government decree in question; which being drawn up in the ensuing month, was accordingly forwarded on the 3d of June. In answer to this, Mr. Secretary Bushby, under date the 10th of the same month replies, that Government refers the Society to the Committee of Public Instructions for its general views on the subject of the address. That owing to financial difficulties, it declines application to the Court of Directors for "specific pecuniary aid in furtherance of native literature," and that it resolves to discontinue the printing of oriental works, (literary) from "a great portion of the limited education fund having hitherto been expended on similar publications," which in its estimation has served for little else than "to accumulate stores of waste paper!" but at the same time it is willing to make over to the Asiatic, or any other Society those parts already printed, if there is any anxiety for their possession. Such is the purport of the Government letter respecting oriental lore, in 1836! When the Consul Mummius sacked the Grecian city, he designated in his ignorance of their value the most precious specimens of painting and sculpture, as mere *waste* lumber. The cases are to our judgment nearly parrallel. As however it would be altogether foreign to our purpose to enter into discussions of this nature, we shall content ourselves with remarking that, taken in its intellectual sense, a more unhappy measure never emanated from the resolutions of this Government. Up to the period of which we are speaking, Government, whatever its errors elsewhere, had been invariably the munificent patron of every thing tending to our illumination in the acquirement of Indian intelligence. Is it to be reserved for a reforming age, and a Government professing to be 'liberal,' to throw us back upon the obscurity of ignorance?

We readily admit the great importance of education in the European languages, but we never can allow that there is nothing of value in oriental literature for it does indisputably tend to illustrate the topography of the country, and the manners and the customs of the people. In the symbolic language of Eastern nations are to be found the philosophic and mythologic reveries of all the existing sects and secret societies. Bacon conceived that the union of spirit and matter was allegorized in the fable of Proserpine being seized by Plato as she was gathering flowers, In this opinion Darwin concurred, because it was rendered curiously exact by the discovery that oxygen is given out of vegetables, and that in this state it is eagerly absorbed by inflammable bodies; he supposed that the fable of Jupiter and Juno, by whose meeting the vernal showers were said to be produced, was merely to pourtray the production of water by the combination of its two elements. The inference to be drawn from these allusions is obvious, that valuable matter is to be found though it must be sought for amidst a mass of superstition and fable. That the Court of Directors came to the same conclusion on the value of oriental literature, the following addressed to the Supreme Government will prove.

FORT WILLIAM,

Public Department, June 19, 1806.

The following Extracts from Letters from the Honorable the Court of Directors, are published for general information:

Extracts from a Letter from the Honorable the Court of Directors, dated the 25th of May, 1798.

Par. 105. "You will have observed by our dispatches from time to time, that we have invariably manifested, as the occasion required, our disposition for the encouragement of Indian literature; we understood, it has been of late years a frequent practice among our servants, especially in Bengal, to make collections of oriental manuscripts, many of which have afterwards been brought into this country. These remaining in private hands, and being likely in a course of time to pay it to others, in which probably no use can be made of them, they are in danger of being neglected, and at length in a great measure lost to Europe, as well as to India. We think this issue a matter of greater regret, because we apprehend, that since the decline of the Mogul Empire, the encouragement formerly given in it to Persian literature has ceased, that hardly any new works of celebrity appear, and that few copies of books of established character are now made; so that there being by the accidents of time, and the exportation of many of the best manuscripts, a progressive dimunition of the original stock; Hindostan may at length be much thinned of its literary stores, without greatly enriching Europe. To prevent in part this injury to letters, we have thought that the Institution of a Public Repository in this country for oriental writings, would be useful, and that a thing professedly of this kind,

is still a bibliothical desideratum here. It is not our meaning that the Company should go into any considerable expense in forming a collection of Eastern books, but we think the India House might, with particular propriety, be the centre of an ample accumulation of that nature, and conceiving also that gentlemen might chuse to lodge valuable compositions, where they could be safely preserved and become useful to the public; we therefore desire it be made known, that we are willing to allot a suitable apartment for the purpose of an Oriental Repository, in the additional buildings now erecting in Leadenhall Street, and that all Eastern manuscripts transmitted to that Repository, will be carefully preserved and registered there.

106. "By such a collection, the literature of Persian and Mahomedan India, may be preserved in this country, after, perhaps, it shall, from further changes, and the further declension of taste for it, be partly lost in its original seats.

107. "Nor would we confine this collection to Persian and Arabian manuscripts. The sanscrit writings, from the long subjection of the Hindoos to a foreign Government, from the discouragements their literature in consequence experienced, and from the ravages of time, must have suffered greatly; we should be glad, therefore, that copies of all the valuable books which remain in that language, or in any ancient dialects of the Hindoos might, through the industry of individuals, at length be placed in safety in this Island, and form a part of the proposed collection."

Extract from a Letter from the Honorable the Court of Directors, dated the 5th of June, 1805.

Par. 26. "In our public letter of the 25th of May, 1798, paragraphs 105, 106, and 107, we informed you, of our willingness to allot apartments for the purpose of our Oriental Repository in the additional buildings then erecting in Leadenhall-Street, and that all Eastern manuscripts transmitted to that Repository, would be carefully preserved and registered there."

28. "We have now to inform you, that the apartments for the Oriental Library, being completed according to our intentions, have been placed under the charge of Mr. Charles Wilkins, formerly of our civil service in Bengal, and that a considerable number of manuscripts, and printed books upon oriental subjects, with objects of natural history and curiosity, have already been placed in it, among which are many valuable presents from individuals and public bodies in this country."

29. "As our original views in establishing this Library, have by no means been abandoned, and we still entertain hopes, that the invitation held out to individuals in India, in the above-mentioned paragraphs, would be successful, if properly seconded by our Supreme Government, we again refer you to them, and desire, that the subject may be entered into with alacrity and zeal."*

Calcutta Gazette.

The present Vol. of the Journal begins with a few introductory observations by the Editor. He informs us that this is the 4th, if taken separately, and 7th year if the Gleanings in Science are included, of the work's existence in its present form. He exhibits what he deems a "satisfactory" aspect of the Society's financial concerns; and proceeds to comment in strong, but measured terms on the conduct of Government in withdrawing its support. He balances this by what he terms the "sunny side of the picture," with some few appointments by which the Government has given employmeut to half a dozen individuals (more or less) which he regards as liberal and praise-worthy. We do not altogether coincide in that opinion excepting the instances of M. Massion and the Munshee Mohun Lol. Government has had a direct prospect of advantage in the appointments it has created, and even in the case of the two first, as their labors lay without the Company's dominions, whence much was to be gleaned which might eventually be turned to use, we are disposed to find some reservation to the integrity of its munificence. We do not mean to cavil at the appointments, because a Government cannot do wrong in legitimately using the talents of able men; but when the object is its own ultimate advantage, we look on it, not as an act of disinterested generosity, *but of fair payment for labor done*, wherein both parties seek what they would gain, with a clear understanding of the motive on either side. We must now conclude these remarks from want of further space, only adding that on one other point we disagree with the learned Editor. It is wherein he observes.—

"Criticism of scientific works published in India has indeed been neglected, and that during a period when the press has been unusually prolific. This department of labour, as far as regards the bringing to public notice new works has been amply fulfilled by the daily press; and beyond this it would be hardly safe to extend the province of criticism in this country, where the Editor cannot conceal his own fallibility under the disguise of an anonymous review."

That the press has done and is manfully doing its duty we willingly allow; but we are unable to perceive why in this country it is "hardly safe" to extend the province of criticism, because our "fallibility cannot be concealed under an anonymous disguise" now in the first place we have yet to learn

the necessity for concealment at all. In the next, we cannot understand the danger of fearlessly expressing our opinions on subjects properly open to discussion, especially if we divest ourselves of rancour in the mode of expressing them. In the field of criticism there are very few who do not find out their "fallibility," and probably none, who in advancing speculative judgments, can hope to escape from controversy. This, however, should not be of force to deter us. Though our attempts may prove short of *infallibility*, there is yet this use in urging them, that we thereby draw forth the opinions of others, and we have been told by our great moralist, that it is only by "much emendation that the truth is elicited."

The Contents of the January No. are—

1. Analysis of a Tibetan Medicine, by M. Alexander Csoma de Körös.

2. Journal of a Tour through Rambree, with a geological sketch of the country, and brief account of the customs, &c. of its Inhabitants. By Lieut. Wm. Foley.

3. Description of the (so called) mountain Trout. By Dr. J. McClelland, Assistant Surgeon 30th N. I.

4. Discovery of the genuine Tea Plant in upper Assam.

5. Abs: meteorol. Observations Nasirabad, by Lieut.-Col. Thos. Oliver.

6. Longitude of Nasirabad, by Lunar transits and by Observers. of Moon, culminating Stars. By Lieut.-Col. T. Oliver.

7. Proceedings of the Assiatic Society.

8. Miscellaneous.

1. Explanation of the differences in the quantity of rain at different elevations.

2. An unusual sea monster in the Bay.

3. Suspension of the Brahmaputra River.

9. Meteorological Register.

From which we propose to make our review and selections in our next publication.

ON RECENT IMPROVEMENTS AND DISCOVERIES IN SCIENCE.

METEORIC STONES.

According to Hofrath Stromeyer, copper exists in all meteoric masses. He examined specimens from Agram, Lenarto, Elbogen, Bitburgh, Gotha, Siberia, Louisana, Brazil, Buenos Ayres, and the Cape of Good Hope, and found in all of them an appreciable quantity of copper, varying from 0·1 to 0·2 per cent., and he came to the conclusion that the presence of this metal must be considered as constant a character of these substances as are the nickel and cobalt, which are found in greater proportion. *(Ann. der Physik,* xxvii. 689.)

Berzelius appears to have entirely overlooked this metal, in meteoric stones, for, in the analysis of a mass from Macedonia, he found Silica 39·56, Protoxide of iron 13·83, Peroxide of iron 5·00, 18·83, Alumina 2·70, Oxide of chromium 0·50, Lime 1·86, Magnesia 26·30, Oxide of Nickel 0·10, Oxide of manganese 2.40, Potash 2.08, Soda 1.20, Total 95·53. (*Kongal. Vetensk, Acad. Hand.* 1828, 156.)

H. Stromeyer examined a mass found at Magdebourg in 1831, the specific gravity of which was 7.30, and its constituents, Iron 74·65, Molybdenum 10·19, Copper 4·32, Cobalt 3·07, Nickel 1·23, Manganese 0·01, Arsenic 2.47, Phosphorus 2·27, Sulphur 92, Silicon 39, Carbon 48, Total 10.000.

Another body found near the Iron Works of Rothehutté, in the Hartz, afforded, Iron 81·14, Molybdenum 1·08, Copper 7·69, Cobalt Nickel 2·40, Manganese 0·14, Arsenic 1·82, Phosphorus ·81, Sulphur ·62, Silicon 1·94, Carbon ·69, Calcium ·29, Total 98,62. (*Ann. des Mines*, v. 568.)

EAINE.—Hermann,* of Moscow, examined a substance termed inflammable snow, which fell on the 11th April 1832, thirteen versts from Wolokalmask, and covered a considerable space of ground, to the depth of 1 to 2 inches. Colour, wine-yellow, transparent; soft and elastic, like gum; sp. gr, 1·1; smelling like ranced oil; burns with a blue flame, without smoke; insoluble in cold water; soluble in boiling water, upon which it swims; soluble in boiling alcohol; dissolves also in carbonate of soda, and acids separate from the solution a yellow viscid substance, soluble in cold alcohol, and which contains a peculiar acid. Analyzed by oxide of copper, it gave Carbon 61·5, Hydrogen 7·0, Oxygen 31·5, Total 100·0

Hermann calls it *Eaine*, signifying *oil of heaven*.

MINERAL—WATERS.

1. SALINE SPRINGS.—Boussingault has observed numerous springs of this nature among the Andes, with iodine in solution, and has remarked that the inhabitants who employed the water of such springs for domestic purposes were free from goitre, a disease extremely prevalent in the elevated parts of South America. They appear indiscriminately in the ancient and modern strata. The most remarkable are those of Guaca, near Medellia, in Antioquia, where the water proceeds from a micacious syenite, covered occasionally by quartzose sandstone, containing layers of pyritic lignite. At the village of Samson, on the Rio Negro, there is a spring which contains so much glauber salt that it is little used. It consists of Chloride of sodium 43, Sulphate of soda 53, Carbonate of soda 1·0, Carbonate of lime 3·0, Iodine a trace 1.

The district of Vega de Supia contains many saline springs. The principal rock is syenitic porphyry, which possesses traces of iodine. Five wells hold in solution the following substances:—

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* Pogg. Ann. xxviii. 566.

	Penol.	Muela.	Ciruela	Mogan.	Quinchia
Chloride of sodium	81·	65·	59·	59·	83·
Chloride of calcium	9·	0·	14·	0·	0·
Chloride of magnesium	1·	0·	14·	0·	0·
Sulphate of soda	0·	31·	0·	37·	9.
Sulphate of lime	9·	0·	13·	0·	0.
Carbonate of soda	0·	4·	0·	1·	0·
Carbonate of lime	0·	5·	0·	2·	8·
Carbonate of magnesia	0·	0·	0·	1·	0·
Iodine	trace	trace	trace	trace	trace
	1·00	1·05	1·00	1·00	1·00

The valley of Magdalena possesses some iodine waters, and that of Cauca a great number.

On the plain of Mira is situated the base of the volcano of Cotocaxo. This plain is covered with sand and common salt, which is most probably derived from the subjacent trachyte, a rock containing glassy felspar imbedded in a basis of pyroxen.

WATER OF SONGRAGNE.—The temperature of this water is $7\frac{1}{2}°$ C. ($45\frac{1}{2}°$ F.) The spring is situated 706 metres ($770\frac{2}{3}$ yards) above the Mediterranean, and arises from a sandstone covered by secondary limestone. The salts present with their water of crystallization are, according to Berther,† Sulphate of soda 12·22, Sulphate of lime 5·85, Sulphate of magnesia 4·68, Chloride of potassium 2·37, Chloride of sodium 74·88. Total 100·00 no trace of bromine or iodine could be detected.

3. SOULTZ.—This water has a specific gravity of 1·2884, and contains Chloride of magnesium 15·84, Chloride of calcium 6·19, Chloride of sodium 10 94, Chloride of potassium 2·08, Bromide of sodium 0·50, Total 35·55,

II. ACIDULOUS WATERS.—I. *Ueberlingen* on the borders of Lake Constance, possesses a copious acidulous spring, which has a temperature 11° to 12°, and a density of 1·002, containing in the pound of 16 ounces, the following substances, by the analysis of Herberger. (*Journ. de Pharm.* xix. 192., Carbonic acid 266·6, cubic inches Azote 43·3) Proto-carbonate of iron 43·424, grams. Proto-carbonate of manganese 3·936, Sub-carbonate of soda 14·600, Sulphate of soda 39·00, Chloride of calcium 30·280, Chloride of magnesium 19·920, Matter containing azote 32·600, Carbonate of lime 88·520, Alumina 6·000, Silica 32·000, Total 360·880.

The ochry substance which it deposits consists of Hydrous protoxide of iron 75·70, Oxide of manganese 00·30, Extractive matter 00·60, Carbonate of lime 13·45, Carbonate of magnesia 2·95, Silica and alumina 7·00, Total 100·00.

This water is employed as a tonic,

2. CRAMAUX.—Its temperature is 4° 5′ C. (40° 1′ F.) 24 litres ($1\frac{4}{5}$ galls.) analyzed by Lamothe‡ afforded Carbonic acid $\frac{1}{2}$ vol. Carbonate of iron 50 gr. Sulphate of iron 12, Carbonate of lime 48, Sulphate of lime 24, Muriate of lime 48, Muriate of potash 48, Sulphate of magnesia 7. Animal matter 3, Total 240,

3. ACIDULOUS WATER OF CAMBON.—M. Blondeau, (*Journal de Pharm.* xxi. 674.) finds this water, which is situated in the department of Cantal, in a clay slate formation to contain Bi-carbonate of soda, Carbonate of magnesia, Carbonate of lime, Sulphate of soda, Chloride of sodium, Carbonic acid, Traces of organic matter.

III. HOT SPRINGS.—In the neighbourhood of the volcanoes of the Cordilleras, according to Boussingault, the temperature of thermal springs does not diminish with the altitude, from which it would appear, that the heat is derived from internal fires. They contain carbonates of lime and magnesia, chlorides of calcium, and sodium, sulphates of soda, lime, magnesia, traces of silica, carbonic acid, and sulphuretted hydrogen gases, (*Ann. de Chim.* 52. 181.)

IV. SULPHUREOUS WATERS.—WATERS OF ST. GENIS.—Professor Lavini procured from a litre (61·02 cubic inches) of this water, 19·5 cubic centimetres, (1·17 cubic inch) of carbonic acid, 5 (0·3 cubic inch) sulphuretted hydrogen, and 17·5 (1.05 cubic inch) of azote, and the following solid contents in the same volume of water: Silica 0·0254 grams. Peroxide of iron 0·0066, Alumina 0·0015, Carbonate of lime 0·0535, Iodide of sodium 0·0136, Sulphate of soda, 0·0151, Carbonate of soda 0·2733, Chloride of sodium 2·1034, Total 2·4924.

St. Genis is situated in Piedmont, about 4 leagues to the East of Turin. The temperature of the water is 5° R. ($43\frac{1}{4}°$ F.) (*Memorie della Reale Accademia, delle Scienze di Torino,* xxxvi. 19.) *Records of Science* 1835.

ON DYSLUITE.

By Thomas Thomson, M. D., F. R. S., &c. *Regieus Professor of Chemistry in the University of Glasgow.*

The mineral of which I mean to give an account in this paper, was sent to me at least seven years ago, by Dr. Torrey of New York; and some years after, I received a fresh supply from Mr. Nuthall. Dr. Torrey informed me in his letter, that it had been discovered by two American Mineralogists, (I think they were Mr Keating and Mr. Vanuxem; though of this I am not quite

† Memoirs. 313.
‡ Journ. de Pharm. xix. 492.

sure, as I have not Dr. Torrey's letter at hand,) who gave it the name of dysluite from its difficult fusibility with carbonate of soda, and who were engaged in analyzing it. This information prevented me from doing any thing more than giving it a cursory examination, which satisfied me that dysluite was a new mineral of rather a curious nature, and highly deserving the attention of mineralogists. Being unwilling to deprive the American mineralogists of the credit which might accrue to them from the analysis, I cautiously abstained from alluding to it, in a paper on the analysis of American Minerals, published in the Annals of the Lyceum of Natural History of New York in the year 1828. But six years having elapsed since that period, and no analysis nor notice of dysluite having appeared in the interval, I take it for granted, that the American gentlemen have relinquished their intention of prosecuting the analysis, and that, therefore, I ought no longer to withhold the knowledge of this curious mineral from mineralogists.

Dysluite occurs at Stirling, New Jersey, interspersed through a dark coloured limestone, and immediately mixed with crystals of octahedral iron ore and several other minerals, which it is unnecessary to describe here. I obtained it by dissolving the limestone in muriatic acid, and picking out the crystals of dysluite from the other crystals and grains with which it was mixed.

Colour yellowish brown, sometimes lighter, sometimes darker. In grains varying from the size of a mustard seed, to that of a pea; most of them crystallized in regular octahedrons. Texture foliated. Lustre of the faces of cleavage splendent, resinous, the faces of the crystals are frequently rough and have little lustre; easily frangible; hardness 4.5; specific gravity 4·551.

Before the blowpipe assumes a red colour but does not fuse, on cooling it resumes its natural colour and appearance. When heated on charcoal it becomes darker but does not melt. With carbonate of soda it does not fuse; but the soda while in fusion appears red, on cooling it resumes its white colour. With biphosphate of soda it does not fuse. The flux while in fusion assumes a fine red colour; when it becomes solid, the colour changes to yellow; and when quite cold, it resumes its usual colours and transparency, the assay remaining unaltered in the centre. With borax it dissolves very slowly. The bead is transparent and has a very deep garnet red colour.

I. To determine the component parts of this mineral, 100 grains of it were reduced to a very fine powder, and heated for an hour in a platinum crucible with thrice the weight of anhydrous carbonate of soda. The mixture had been fused, and when cold had a fine green colour, indicating the presence of manganese in the mineral. On digesting the fused mass in muriatic acid, 67 grains of the mineral remained undecomposed.

This residue was again fused with thrice its weight of carbonate of soda, and kept for an hour in a strong red heat; the fused mass was similar to the former. Being digested in muriatic acid, 33 grains of the mineral still remained undecomposed.

These 33 grains being terated with thrice their weight of carbonate of soda as before, the whole dissolved in muriatic acid, except a few flocks; which being heated a fourth time with carbonate of soda, and the mixture digested in muriatic acid, a complete solution was obtained.

2. The solution in muriatic acid had a strong yellowish red colour, shewing that the mineral contained much peroxide of iron. They were all mixed together and evaporated to dryness in a porcelain dish.

3. The dry mass, which had a yellow colour, was digested for an hour in water, acidulated with muriatic acid, and then passed through a filter. There remained on the filter a white powder, which, being washed, dried and ignited, weighed 2 grains; dried by the blow-pipe, it melted with effervescence into a transparent colourless glass with carbonate of soda, and was not soluble in acids. It was, therefore, *silica*.

4. The liquid which had passed through the filter, together with the washings, was evaporated down to a manageable quantity. It was then neutralized and precipitated by caustic ammonia, added in excess. The whole was thrown on a filter, and the yellowish red residue on the filter well washed. The colourless liquid which passed through the filter was concentrated on the sand-bath, partly to drive off the excess of ammonia, and partly to reduce it to a manageable quantity; during the concentration white flocks fell. The quantity of this precipitate was much increased on adding carbonate of soda to the liquid.

This precipitate was collected on a filter, washed and dried. It possessed the following properties:

(1.) When heated to redness, it became yellow, but resumed its white colour on cooling.

(2.) Soluble in sulphuric, nitric and muriatic acids. The solutions colourless; and when neutral, possessed the peculiar taste which characterizes the salts of zinc.

(3.) The nitric acid solution precipitated in white flocks by caustic ammonia, re-dissolved by an excess of the precipitant.

(4.) Precipitated in white flocks by caustic potash, and re-dissolved by an excess of the precipitant.

(5.) Precipitated in white flocks by the alkaline carbonates, and not re-dissolved by an excess of the precipitant.

(6.) The sulphuric acid solution being cautiously evaporated, yielded transparent white crystals in four-sided prisms, almost rectanglar, and easily recognizeable as sulphate of zinc.

It is obvious that the powder thus obtained was oxide of zinc.

To the liquid from which this precipitate had been obtained, oxalate of ammonia was added, and the liquid concentrated. In this way an additional precipitate was slowly obtained, which was oxalate of zinc.

All these precipitates being collected and exposed to a strong red heat, left 16.8 grains of oxide of zinc.

5. The red precipitate collected on the filter, (in paragraph 4) was well washed, and while still moist, dissolved in muriatic acid. This solution was mixed with a great excess of caustic potash, and boiled for two hours in a porcelain vessel; the whole was then passed through a filter. The liquid which passed through was colourless; the matter remaining on the filter was dark red.

6. The potash solution which thus passed through the filter, together with the washings of the filter, was evaporated to dryness in rather a strong heat, and the dry residue being mixed with water, was digested (in the cold) in muriatic acid. A white powder remained undissolved, which, being separated and ignited, weighed 13.04 grains. It possessed the following characters.

(1.) When heated before the blow-pipe with nitrate of cobalt, it assumed a beautiful blue colour.

(2.) It dissolved by heat in sulphuric acid, and the solution being mixed with a solution of sulphate of ammonia, yielded crystals of alum. The powder then was *alumina*.

7. The muriatic acid solution being supersaturated with carbonate of ammonia, white precipitate fell, which being separated and ignited, possessed the characters of alumina, and weighed 17.45 grains.

Thus, the whole alunina extracted from the mineral was 30.49 grains.

8. The dark red precipitate which was collected on the filter (in paragraph 5) being dried and ignited, weighed 50·53 grains.

9. It was digested in muriatic acid. The whole dissolved except a white powder weighing 0·996 grains. It was silica slightly impregnated with iron.

10. The muriatic acid solution was mixed with carbonate of ammonia till it was rendered as neutral as possible; indeed a few flocks had precipitated. It was then heated in a flask. Carbonic acid gas escaped in abundance, and the whole peroxide of iron was precipitated. The whole was thrown on a filter, the oxide of iron was collected on the filter and washed; the colourless solution which passed through being mixed with carbonate of ammonia, a white precipitatee fell, which became brown by strong ignition, and possessed the character of oxide of manganese. It was equivalent to 7·76 grains of protoxide of manganese.

11. The peroxide of iron remaining on the filter being dried and ignited, weighed 41·774 grains.

From the preceding analysis the constituents of dysluite appear to be

		Atoms.	
Alumina..	30·490	13·55	8·
Oxide of zinc..........	16·800	3·2	1·89
Peroxide of iron........	41·774	8·38	4·6
Protoxide of manganese.	7·760	1·69	1·
Silica..	2·996	1·498	0·88
Water................	0·400		
	100·12		

If we admit the silica to be only an accidental mixture, it is evident that dysluite consist of

8 atoms alumina
2 ,, oxide of zinc
5 ,, peroxide of iron
1 ,, protoxide of manganese.

The alumina obviously acts the part of an acid, as it does in spinell, automolite, sapphirine, and candite. But in all of these, several atoms of alumina unite with one of the basis, which are manganese and peroxide of iron. But dysluite is composed of simple aluminates, the formula exhibiting its constitution, being

$$5\,f\,\text{Al.} \times 2\,\text{Z Al.} \times mn\,\text{Al.}$$

It is worthy of remark, that the crystalline from of dysluite is the regular octahedron, the same from which spinell and all the other crystallized minerals, in which alumina acts the part of an acid, assume.

Note.—The four minerals mentioned, in which alumina acts the part of an acid in union with a base, have their composition represented by the following formulæ, as deduced from analyses made in the laboratory at Glasgow.

1 Spinelle,	Sp. Gr.	3·523	M Al.^6
2 Sapphirine	,,	3 428	$2\,\text{M Al.}^6 + \text{MS}$
3 Candite	,,	3·617	$8\,\text{M Al.}^2 + 5f\text{Al.}^{2\frac{1}{2}}$
4 Automalie	,,	4 261	Z Al.^6
To which may be added Chrysoveryl	,,	3·711	$6\text{Gl.Al.}^6 + f\text{Al.}^{1\frac{1}{2}}$

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PHILOSOPHICAL TRANSACTIONS.

FOR 1834, PART II.

(*Continued from* p. 20.)

II. INTENSITY NECESSARY FOR ELECTROLYZATION.—In this part of the paper the author demonstrates that by producing a current by the action of sulphuric acid upon amalgamated zinc in one vessel, passing it through acid in a second vessel by platinum electrodes, a current may pass for a long period, but may be of so low an intensity, as to fall below that degree at which the elements of water unassisted by any auxiliary force capable of forming a combination with the matter of electrodes, separated from each other. He found that a solution of *sulphate of soda* can conduct a current of electricity incapable of decomposing the neutral salt present; that this salt, in a state of solution, requires a particular intensity for the separation of its elements, and that the requisite intensity is superior to that necessary for the decomposition of *iodide of potassium*, likewise in solution. Fused *chloride of lead* can also conduct a current having an intensity below that required to effect decomposition. Fused *chloride of silver* is docomposed by a similar current. A drop of water and fused nitre conducted a current without decomposition. It appears, farther, that the necessary electrolytic intensity for water, is the same whether it be pure, or rendered a better conductor by the addition of acids, for the power of acids, alkalies, salts, and other bodies in solution to increase conducting power, appears to hold good only where the

electrolyte through which the current passes undergoes decomposition.

Currents of electricity produced by less than eight or ten series of voltaic elements can be reduced to that intensity at which water can conduct them without suffering decomposition, by causing them to pass through three or four vessels, in which water shall be successively interposed between platinum surfaces.

This subject is worthy of prosecution, in order to enable us to arrange electrolytes in the order of their electrolytic intensities. In terminating this portion of his paper, the author observes, in relation to intensity generally, that when a voltaic current is produced, having a certain intensity dependant upon the strength of the chemical affinities by which that current is excited, it can decompose a particular electrolyte without relation to the quantity of electricity passed, the descomposition of the electrolyte being produced, if the intensity is too high. If this be confirmed, then we may arrange matters so that the same quantity of electricity may pass in the same time into the same decomposing body, in the same state, and yet differ in intensity, decomposing in one case, and in the other not.

III. VOLTAIC BATTERY.—From the principles laid down, it is evident that the quantity of electricity in the current cannot be increased by multiplying the quantity of metal oxidized; a single pair of plates, throwing as much electricity into the form of a current, by the oxidation of 32·5 grs. of zinc as would be produced by increasing the quantity of oxidized metal a thousand times. For the action in each cell is not to increase the quantity set in motion in any one cell, but to assist in urging that quantity forward, and in this manner, the *intensity*, is increased without affecting the *quantity*, beyond what is proportionate to the zinc oxidized in any single cell of the series. Ten pairs of amalgamated zinc and platinum plates, when acted upon by sulphuric acid, produced such a quantity of gas as to prove that just as much electricity, and no more, had passed through the series of ten pairs of plates, as had been transmitted through or would have been put in motion by any single pair, notwithstanding the consumption of ten times the quantity of zinc. All these facts tend to shew that the act of decomposition opposes a certain obstruction to the passage of the electric current, and that this opposing force is overcome in proportion to the intensity of the decomposing current. When ordinary zinc is used in a voltaic pile, the waste of power is very great, for 3½ ounces of zinc, properly oxidized, can circulate a current capable of decomposing nearly an ounce of water, and of evolving 2400 cubic inches of hydrogen. This waste, however, is greater with common zinc than with the pure metal, for, when common zinc is acted upon by dilute sulphuric acid, portions of copper, lead, cadmium, are set free on its surface, and form small but active voltaic circles, which act apparently on the zinc surface, but, in reality, upon those accidental metals. This effect is removed by employing amalgamated zinc plates, which afford the full equivalent of electricity for the oxydation of a certain quantity of zinc, but are active only when the electrodes are connected. This improvement in the voltaic battery is of great importance, for effects of decomposition can now be obtained with ten pairs of plates, which formerly required 500 or 1000 pairs of plates. Dr. Faraday conceives that in further improving the battery, plates of platinum or silver may very likely be used instead of copper, in order to avoid the occasional solution of the copper, and its precipitation on the zinc.

IV. RESISTANCE OF ELECTROLYTES TO ELECTROLYTIC ACTION.—By interposing a platinum plate, and adding sulphuric acid to a pair of zinc and platinum plates, the current was completely stopped, by requiring it to decompose water, and evolve both its elements before it should pass. The same effect almost was produced when two pairs of plates were used, and one interposed plate. But, in the case of three pairs of plates, a current was induced which passed an interposed platinum plate, but was stopped by two. The current originated by four pairs of plates was also obstructed by two interposed platinum plates. Five pairs of zinc and platinum, with two interposed platinum plates, yielded a feeble current. Six voltaic plates, and four intervening platinum plates, induced a feeble current. The effects of retardation were altered when a variety was made in the nature of the liquid employed between the plates, nitric acid appearing to increase the intensity of the current, muriatic acid transmitting a current more easily than pure sulphuric acid. Increasing the strength of the sulphuric acid caused no change in the effect.

On varying the nature of the interposed plate, it was found that with one voltaic pair and one interposed zinc plate, as powerful a current was induced as if the interposed zinc plates was absent. With two amalgamated zinc plates there was still a powerful current, but some obstruction occured. On using three intermediate zinc plates, there was still further retardation, though a good current of electricity passed. Plates of copper seemed at first to occasion no obstruction, but after a few minutes the current almost entirely ceased.

All these retarding effects exhibit most distinctly the chemical relations and source of the current, and add to the evidence of the identity of the two.

V. REMARKS ON THE VOLTAIC BATTERY.—The action of the battery is weakened by the formation during its activity of substances which may even tend to produce a counter current. In an experiment made by Faraday, the retardation of the current was obviously referable to the state of the film of fluid in contact with the zinc plate, the acid of the film being instantly neutralized by the oxide formed.

A *second* cause of diminution in the force of the voltaic battery, is, that extraordinary state of the surfaces of the metals described by Ritter, which causes them to oppose the passing current.

The author directs, Ist. That weak and exhausted charges should never be used at the

same time with strong and fresh ones, in the different cells of a trough, or the different troughs of a battery, because, the plates in the weaker cells retard the progress of the electricity originating in the stronger cells.

2d. The associating of strong and weak pairs of plates should be avoided, as one part is apt to act an interposing plate.

3d. Reversing tin plates, either by accident or otherwise, has an injurious effect, by opposing the current in a manner similar to interposed plates of platinum. For, in a series of four pairs of zinc and platinum plates, in dilute sulphuric acid, if one pair be reversed it almost neutralizes the power of the whole. Other causes affect the passage of the electrical current, and there is one especially of common occurrence, viz : when the copper is precipitated upon the zinc in the cells.

OBSERVATIONS ON TORPEDO.

By Dr. Davy.

Dr. Davy's paper on the Torpedo *oculata and diversicolor*, termed indiscriminately by the Maltese, *Haddayla*, contains some experiments on the electricity of these species of animals, which establish the anticipation of Faraday, that by the application of Harris's electrometer to the torpedo, the evolution of heat would be observed. In his experiments detailed in a former volume of the Transactions, it was demonstrated that the electricity of the torpedo is capable of acting like voltaic electricity in effecting chemical decompositions. He enumerates at present all the tests or indications of the electricity of the torpedo now known, which are, 1st, the philosophical effect, as the sensation it imparts is sometimes calls : 2d, the chemical precipitation of iodine, the decomposition of water, &c. : 3d, its effect on the thermometer, galvanometer, and on steel in the spiral. These tests are in point of delicacy, in the order in which they are enumerated. Dr. Davy has been unsuccessful in his attempts to elicit a spark from the torpedo, although it has been said that a spark has been obtained from the *Gymnotus electricus*.

With regard to the seat of the electrical power, it appears that when the brain has been divided longitudinally, the fish has continued to give shocks. When the brain was completely removed the fish instantly lost this power. Humboldt stated that a shock may be procured by touching only one surface of the fish, but Davy finds that it is necessary to touch the opposite surface of the electrical organs, or a conductor or conductors connected with them, before a shock can be received. On some occasions a shock was received when only one surface was apparently touched, but in that case the discharge probably took place through the water, and when one surface is touched, the animal instinctively makes an effort to bring the other surface in contact with the offending body.

There appears, however, to be no connexion between the muscular and electrical power. Two views may be taken of the phenomenon. It may be considered either, 1st, a form or variety of common electricity; or 2d, a distinct kind; or 3d, not a single power, but a combination of many powers. The first opinion is supported by Dr. Faraday. The only objection to it is the interruption of the torpedinal electricity by the smallest quantity of air, and its want of the power and attraction of the air, which affords some foundation for the second idea.

The origin of the electricity of the fish may also be urged as an argument for its specific nature, but without much plausibility, because, we are ignorant of its cause and nature. The third opinion may serve as a guide for more minute investigation. The author suggests that other varieties of electricity may owe their effects to the union of several powers, or ethereal fluids, and their peculiarities to the predominance, in various degrees, of these fluids. Dr. Davy found the skin covering the electrical organs, deeper coloured and thicker than below, more vascular, with stronger muscles, and more mucus, the under surface having a greater supply of cutaneous nerves, and a blood-vessel enlarged into a little bulb, situated one on each side of the porta, below the plexus of nerves supplying the pectoral fin, the use of which may be to propel the blood into the pectoral fin and electrical organ.

EXPERIMENTS ON THE VELOCITY OF ELECTRICITY.

By Mr. Wheatstone.

The only remaining paper connected with electricity, in this portion of the Transactions, consists of an account of experiments by Mr. Wheatstone, on the velocity and duration of electric light. In 1747 Dr. Watson found discharges through a circuit, of four miles in extent, two miles through wire and two through the ground, to be apparently simultaneous. Mr. Wheatstone repeated a similar experiment, substituting for the imperfect judgment of the eye, a revolving mirror. This instrument revolved 800 times in a second, and during this time the image of a stationary point would describe 1600 circles; the elongation of a spark through half a degree, a quantity obviously visible, and equal to one inch seen at the distance of 10 feet, would therefore indicate that it exists the 1,152,000th part of a second. The deviation of half a degree between the two extreme sparks, the wire being half a mile in length, would indicate a velocity of 576,000 miles in a second. This estimation is on the supposition that the electricity passes from one end of the wire to the other: if, however, that two fluids in one theory, or the disturbances of equilibrium in the other, travel simultaneously from the two ends of the wire, the velocity measured will be half that in the former case, or 288,000 miles in a second. The greatest elongation of the sparks was 24°, indicating a duration of about the 24,000th part of a second. The general conclusions which the author draws from his experiments are, 1st. The velocity of electricity through a copper wire exceeds that of light through the planetary space. 2d. The disturbance of electric equilibrium, in a wire communicating at its extremities with two coatings of a charged jar, travels with

equal velocity from the two ends of the wire, and occurs latest in the middle of the circuit 3d, The light of electricity in a state of high tension, has a less duration than the millionth part of a second. 4th, The eye is capable of perceiving objects distinctly which are presented to it during the same small interval of time.

PHYSICS, &c.

Mr. Hamilton's paper on a general method in Dynamics is a most elaborate one. He shews that in the method formerly employed to develope the laws of motion, the determination of the motion of a free point in space, depends on the integration of three equations, in the ordinary differentials of the second order, and the determination of the motions of a system of free points attracting or repelling one another, depends on the integration of a system of such equations, in number threefold the number of the attracting or repelling points, unless we previously diminish by unity this latter number, by considering only relative motions. Mr. Hamilton's method is to reduce the problem to the search and differentiation of a single function, which satisfies two partial differential equations of the first order, and of the second degree, and every other dynamical problem respecting the motions of any system, however numerous, is reduced, in like manner, to the study of one central function.

THEORY OF CLAIRAUT.

Mr. Ivory demonstrates that the beautiful theory of Clairaut, which assumes for the foundation of its superstructure, a mass of fluid in equilibrium, and that the pressure of every new stratum upon the surface of which it is laid, is caused solely by the forces in action at that surface, is very satisfactory when no cause of motion emanates from the fluid itself, and all the forces in action depend merely on the place of a particle, but is defective when applied to fluids consisting of particles that act upon one another by attraction or repulsion; Clairaut having omitted to attend to the attraction of the stratum, which is not infinitely little in its effect upon the motion of a particle, and is expressed by the difference of two definite integrals. The correction of Clairaut's theory is very important; because, to him belongs an essential part of the theory of the earth, and he was the first that entertained correct notions respecting the effect to alter the form of the terraqueous globe, produced by heterogeneity in its structure. In the theory of the French philosopher, the equations of the upper surface of the fluid, and of all the level surfaces underneath it, are derived from the single expression of the hydrostatic pressure, and are dependant on the differential equation of the surface.

They require, therefore, that this latter equation be determinate and explicitly given; and accordingly, they are sufficient to solve the problem, where the forces are known algebraical expressions of the co-ordinates of the points of action, but they are not sufficient when the forces are not explicitly given, but depend as they do in the case of a homogeneous planet on the assumed figure of the fluid. In the latter case, the solution of the problem requires farther, that the equations be brought to a determinate form, by eliminating all that varies with the unknown figure of the fluid.

The author establishes a theory on the subject, applies it to the principal problems of the equilibrium of a homogeneous fluid at liberty, and demonstrates that the figure of equilibrium of a homogeneous planet can be no other than an oblate elliptical spheroid of revolution.

ON THE EFFICIENCY OF PADDLE WHEELS.

Mr. Barlow draws the following inferences from the results of various experiments made to determine the efficiency of paddle-wheels of steam-boats, so constructed as to make the floats enter and leave the water nearly in a vertical position, as compared with common wheels, and with relation to the consumption of fuel; 1. When the wheel is but slightly immersed, little advantage is gained by the vertically acting paddle; 2. When deeply immersed, the vertical paddle has considerable advantage over the common wheel.

3. When the position of the common wheel is vertical, it affords less resistance to the engine, and is less effective than in any part of its revolution, which is exactly reversed in the case of the new wheel.

4. In any wheel, the larger the paddles the less is the loss of power; because, the velocity of the wheel is not required to exceed that of the vessel in so high a degree, in order to acquire the resistance necessary to propel the vessel.

5. With the same boat and the same wheel no advantage is gained by reducing the paddle so as to bring out, as it is called, the full power of the engine, the effect produced being merely to increase the speed of the wheel, and consume steam to no purpose.

6. With the same boat and the same wheel the speed will be increased by diminishing the diameter, or by reefing the paddles, the increase of speed being in the ratio of the square roots of the radii, or the cube roots of the powers employed. This is important in long voyages, where the immersion of paddles is great, in consequence of the quantity of the coals with which steam vessels are required to be laden. An increase of speed will be given, amounting to nearly one mile per hour, by reducing the diameter of the wheel so as to allow the engine to perform its full duty.

7. An advantage would be gained by a wheel of large diameter, as far as the immersion of the paddle produced by loading the vessel is concerned, as it would not so sensibly affect the angle of inclination at which it entered the water. But, to have large wheels, it is necessary either to have the engines made with long strokes, or to have the paddle-wheel on a different shaft, in order to diminish the speed.

ANATOMY AND PHYSIOLOGY.

Sir Charles Bell, in his paper on the brain begins by enumerating some of the impediments which have retarded the discovery of the structure and functions of that organ. 1. The nature of the inquiry, since opposite results must be expected in making investigation upon a subject so delicate. In practice, we find effects produced by causes which seem quite inadequate. The presence of a small specula of bone will sometimes be attended by no consequence, and at other times will give rise to violent convulsions. 2. The disturbance of its circulation, for no organ depends more intimately upon the condition of the circulation within it than the brain. 3. The most frequent source of error is the obscurity which hangs over the subject, for not one of the grand divisions of the brain has yet been distinguished by its function. Hence have arisen imaginary theories which always tend to bury a science in obscurity. The present inquiries of the author are directed to the prosecution of the fact discovered by himself, that the nerves of motion and sensation originate from different sources. He follows up these tracts ; marks the portion of the brain to which they ultimately tend ; ascertains the effect of diseases on these parts, and compares the system with the anatomical details. The consequences which he has drawn from this investigation are : 1st, that sensibility and motion belong to the cerebrum : 2d, that two columns descend from each hemisphere, one of which the anterior, gives origin to the anterior spiral roots of the spinal nerves, and is dedicated to voluntary motion ; the other sends out the posterior roots of the spinal nerves, and the sensitive root of the fifth nerve, and is the column for sensation : 3d, that the columns of motion which come from different sides of the cerebrum, join and decussate in the medulla oblongata, and that the columns of sensation also join and decussate in the medulla oblongata : 4th, that these anterior and posterior columns bear, in every circumstance, a very close resemblance to one another, agreeing in their sensorial expansions, being widely extended in their hemispheres, and in every respect, except in the nervous filaments to which they give origin.

The anatomical descriptions are illustrated by drawings, which will be found particularly serviceable in unravelling, as far as anatomy can at present carry us, some of the intricacies of the cerebral organ. The pons varolii, we observe, in an especial manner, has received much attention from the distinguished author.

ON THE GENERATION OF THE MARSUPIAL ANIMALS.

By R. Owen, Esq.

The generation of Marsupial animals, which constitute a distinct tribe of mammalia, of which the kangaroo and opossum are the principal members, has hitherto been involved in much obscurity. But Mr. Owen, who has been fortunate enough to have it in his power to examine the gravid uterus of a kangaroo, has observed some important facts. The genera of this tribe are characterized by possessing a double uterus, and the true vagina is separated either wholly, or for a considerable extent, into lateral canals, while the digestive and generative tubes both terminate within a common cloacal outlet. In these respects, therefore, they approach the oviparous verterbrata. The fœtus examined by the author was contained in the left uterus. No placental structure could be observed. The chorion was very thin. A transparent amnios enveloped this fœtus. The umbilical chord was two inches in length ; the uterus two inches in length, and above an inch in diameter. No perceptible trace of an allantois or urinary bladder could be detected ; but in another fœtus two weeks old, a urachus was detected. The author concludes from the observations of others, coupled with his own, that the ovulum quits the ovisac as in ordinary *mammalia*. In the kangaroo uterine gestation continues 39 days ; in the opossum 26 days. The former has been determined with certainty in the Zoological Gardens, and therefore, overturns the statement of Hilaire, who made the period 4 months.

With regard to the relation between the size of the umbilical vesicle, the least vascular placenta and a corresponding simplicity of brain, it appears that in the kangaroo, although shortly after birth the brain resembles in structure that of the lowest *vertebrata*, yet it afterwards assumes a more complex form than that of the opossums or dasyures. The individuals of the marsupial tribe seem low in intelligence, never manifesting any sign of recognition of their keepers or feeders, and being unable to utter vocalized sounds. When they are irritated they emit a wheezing or snarling guttural sound, the necessary apparatus for producing vocalized sounds being absent. In this respect they resemble the *reptilia*.

In the author's communication on the *ornithorhyncus paradoxus*, this idea of similarity and that lactation might co-exist with a mode of generation essentially similar to that of the viper and salamander is fully confirmed. The regular gradation is traced which exists in different orders of mammalia, in which true viviparous or placental generation takes place, towards the ovo-viviparous or oviparous modes, in which the exterior covering of the ovum never becomes vascular. The *ornithorhyncus* is shewn to constitute a connecting link in the chain. Both of these papers are accompanied by plates.

ON THE STRUCTURE AND FUNCTIONS OF TUBULUR AND CELLULAR POLYPI AND OF ASCIDIÆ.

By J. Lister, Esquire.

Mr. Lister has observed the existence of currents within some zoophytes.* In the

* The use of this term has been much rebrobated by Lamark, but notwithstanding his censure it still continues to be employed by many distinguished naturalists ; and it is sufficiently expressive of a class of beings whose nature is still involved in great obscurity.—Edit.

Tubularia indiviss, a current of particles was seen within its tube, which, in its combined and steady flow, resembled the circulation in plants of the genus *chara*. The general course of the stream was parallel to the slightly spiral lines of irregular spots on the tube. Between the stomach and the mouth a remarkable action was observed. The mouth became swollen by a flow into it from the stomach, which continued for about a minute. The contents of the mouth were then squeezed back into the stomach, and during this reflux the connecting orifice was seen distinctly open, and it continued so till the stomach became nearly empty. The orifice then closed gradually, preparatory to the effort of forcing the fluid back to the stomach. Two currents were continually going on both in the mouth and stomach, one flowing down the sides and an opposite one in the axis.

These observations were made by a microscope which magnified 100 times, and drawings were taken by a camera lucida slid over the eye piece.

In the *Sertularia pluma* Ellis, a current was observed flowing in the channel backwards and forwards through the main stem and lateral branches of a pluma, and might be compared to the running of sand in an hour glass, five ebbs and flows occupying 15½ minutes. When the connexion of a plume with the root was interrupted by bending its stem, the stream running down the middle was observed to continue its flow up one of the lower and stronger lateral branches, and then to return down that branch and up the main stem. The section of a stem made below the commencement of the side branches exhibited a small stream apparently followed by viscid matter. Cavolini first observed this, but no subsequent writer has noticed it. In *Sertularia pumila*, an irregular motion was noticed in the stomach and mouth, and likewise, but not distinctly, in *S setacea*, *dichoma*, and in species of *Campanularia*.

In a small *Ascidia* occurring on the *conferva elongata*, circulation was observed through the transparent coat, the particles of the blood not exceeding ·00025 inch in diameter. The blood enters the heart from the peduncle, the ventricle contracts in the middle and drives the fluid into the branchial organ, and into a network of vessels over the stomach and intestines. After the circulation has gone on for a while, the pulsations become fainter and gradually cease when the current is reversed. A *Polyclinum* exhibited also internal motions.

In *Cellularia* and *Flustra* none of the internal currents which in the sertulerīæ connect the different parts of the zoophyte were observed, nor was any circulation detected. Each animal is enclosed in its cell, and sends out its mouth and arms through a valve. A short sheath precedes them, from whence the arms rise straight together, and then open to a funnel-shaped figure of beautiful regularity, serving probably to draw food to the mouth by currents. Between the animals of these genera no line of distinction could be detected. From these physiological observations, corrections may be brought about of the arrangement of many species. The *Cerialaria lendigera* he removes from the *Certulariæ* and the *Anguinaria anguina* from the *Tubulariæ* to the *Cellular polypi.*

ON THE NERVOUS SYSTEM OF THE SPHYNX LIGUSTRI.

By G. Newton, Esq.

In the paper of Mr. Newport, a minute detail is given of the nervous system of the *Sphynx ligustri* during the latter stages of its pupa and imago states, and on the means by which its developement is effected. During the passage of the insect from the larva to the pupa state, the gauglia and nervous cords undergo great changes both in their form and situation, and likewise in their number; and after these changes have been carried to a certain extent, they are suspended for several weeks, during which the insect hybernates. At the end of this period the changes again proceed. The insect remains in the pupa state about 43 weeks, and during this period the concentration of the nervous system proceeds to a much greater extent. The author describes the double origin and connexions of the nerves distributed to the wings, the object of which appears to be, to establish a harmony of action between the wings in those insects especially, which are remarkable for velocity and power of sight, a different structure being adopted in those which fly with less regularity or speed.

A *pneumogastric* nerve or *par vagum* is described, which is distributed to the organs of digestion and respiration. The author likewise notices lateral cephalic ganglia, which may be regarded as auxiliary brains, and a sympathetic nerve; besides a set of nerves which appear to correspond with the respiratory nerves of vertebrated animals. The primary longitudinal nervous cords of insects are shown to consist of two tracts, the one situated over the other, corresponding to the two columns of which the spinal cord consists in vertebrated animals; the one forms the seat of sensation, and the other of motion. The same observation has also been made upon the lobster, *Scorpion*, and *Scolopendra*, and in several insects, as the *Gryllus viridissimus*, the *Carabus*, and *Papilio urticae*.

Such are the principal papers of which this portion of the Philosophical Transactions consist. The substance of Mr. Powell's paper, with additions, is inserted in a preceding part of this Journal. It is rather remarkable, that with the exception of a short notice of a mineral water, there is no purely chemical paper contained in it.—*Records of General Science* 1835.

EMPLOYMENT OF GYPSUM IN AGRICULTURE.

Gypsum has been employed in Switzerland, Germany, England, and North America for many years as a manure, but it was only brought into use in France about forty years ago. At present it is very generally used in that country, with the exception of the departments of Gard and Herault. (*Ann. des Mines*, vi. 193.)

For the purposes of agriculture it is sometimes calcined, which deprives it of its water of crystallization, which in the hydrous gypsum amounts to 2 atoms. This preparation is attended to in France, where the expense of the process is less than in other countries. In England, Germany, &c. it is generally employed in the crude state. The effect which calcination produces, is to render the gypsum more rapid in its operation, though the beneficial effects are less durable. In France it is burned in a kind of lime kiln by means of coal, after being reduced to powder.

It can be obtained in this state in Gard, for one shilling the 110 lbs. avoird., and it costs double the expense in Alais. Extensive natural deposits occur in England in the neighbourhood of the Humber, from whence it is brought to Glasgow and Manchester for the use of the bleachers, who now employ it in considerable quantities. Its purity may be negatively tested by vinegar, which, if it causes no effervescence, shews that there is no carbonate of lime present. If it swells up when water is thrown on it, and then assumes consistence, it is a sign that it has been properly calcined. The best plaster will absorb the greatest quantity of water. It is chiefly on artificial meadows that we observe the best effects from its application, more especially on clover, lucern, sainfoin, and in general on the leguminous tribe of plants possessing large and thick leaves. It has a powerful effect also upon natural meadows which contain much clover, vetches, and other analogous plants; but upon the grasses the effect of gypsum is trifling. It acts, according to M. Thibaud, by extracting the moisture from the air, and stimulating the vital action of plants.

It sometimes doubles the product of clover, lucern, and sainfoin. In France it is sowed like corn with the hand, about March or April when the plants are a few inches above the soil, so as to allow the gypsum to fall on the leaves. It should be done previous to rain, but not during the fall of rain, or the existence of wind, or during frost.

The quantity of gypsum applied to the land must vary of course with the nature of the soil. In the course of fifteen or twenty days the good effects resulting from its use are visible, if circumstances have been favourable. The benefits of one application last for two or three years, so that it is unnecessary to spread it every year. In Gard and Herault sainfoin is principally cultivated for pasture, and seems to thrive well in dry soils, especially in stony calcareous situations. About Alais, for the cultivation of this plant in artificial meadows, the ground is first ploughed in November, then again in December, and the seed is sown in the beginning of April.

In Provence and in the southern parts of Languedoc, where the effects of frost are less dreaded, it is sown in autumn. The sainfoin thus cultivated in inferior soil affords one or two crops in the year, and lasts for four or six years; then it is ploughed up and corn is substituted for it. It is worthy of remark, that lands which previously could not produce corn, has, by the use of gypsum in the manner described, been able to raise good crops in the midland parts of France. The agriculturists of Alais may procure gypsum from Anduze, Salle, Rochebelle, and Blanaves. To Drome it may be carried from Gard and Ardeche. At Herault it may be otbained at Cruzy, Quarante, Calzouls, Herepain, Beziers, Clermont, Loubes, and Lodeve. It is extensively employed in Canada with the most happy results. It was tried in Yorkshire by Lord Dundas without any benefit, but the soil upon which it was spread was ascertained to contain a quantity of gypsum. It might be employed, there can be little doubt, with great advantage in the border counties, where the *trifolium pratense* has in many places failed. This plant necessarily from its strong and luxuriant nature, obviously must require a considerable quantity of the manure. If it be deficient in quantity the plants may vegetate, but must speedily perish from the effect of the first frost on their delicate structures.

ROYAL INSTITUTION.—COMPARISON OF THE NEWTONIAN AND UNDULATORY THEORIES OF LIGHT.

30th January.

Dr. Ritchie commenced his lecture on the two theories of light which have been advocated by different philosophers for many years, with a few observations with regard to the difficulty of acquiring knowledge of the subject by direct experiment, in consequence of the almost spiritual nature of the substance upon which it is necessary to operate.

Newton whose opinion was long in vogue, having had his attention directed to the motions of bodies, considered light as a substance consisting of revolving spherical particles issuing from luminous bodies moving in straight lines, and producing reflection or refraction according as the extremities of the spheres, which came in contact with a denser medium, were sharp or obtuse. This theory required certain postulates which appear, however, to be entirely gratuitous. By the undulatory theory, which is often called the theory of Huyngens, which was suggested to his mind in cosequence of his attention being directed to the motions of the pendulum, although it was known before his time, light is considered to consist of the undulations of an ethereal fluid filling all space, and existing between the particles of bodies. If such a fluid does exist, we might expect that it would act in retarding the motions of the heavenly bodies. It is obvious, however, that the plants can suffer no retardation, because, in consequence of their revolutions, the ether will also acquire motion and be carried along with them, but in reference to the comets, which are extremely light bodies, we find a decided retardation, which after making all allowances, can only be accounted for on the supposition of the existence of an etherial medium. This has been clearly proved by Sir John Herschel, in his article on light in the Encyclopædia Metropolitana. Dr. Ritchie stated that he had only become a convert to the undulatory theory of light about two years ago, in consequence of Herschel's arguments, and an attentive comparison of the two theo-

ries. This ether, then, is supposed to exist in the pores of all bodies, being more dense in solid bodies than in empty space, but possessing less elasticity. An impulse being given it, a succession of waves is produced, precisely like sonorous vibrations which strike upon the retina and cause that membrane to move backwards and forwards, or vibrate, as the undulatory motions of the air, excited by sonorous bodies, occasions motions in the membrana tympani. These vibrations follow in regular succession, and according as they are more or less frequent or rapid in succession, the sensation of colour is produced.

The following table exhibits the number of vibrations which are distinguishable in a second, and the length of a wave:

Number of vibrations.	Length of a wave.
32	32
64	16
128	8
4096	3 inches.
8192	1 ½

The number of vibrations which produce the different colours of the spectrum has been calculated with wonderful precision:

Red 458,000,000,000,000, Orange 506, Yellow 635, Green 577, Blue 622, Indigo 658, Violet 727. The length of a wave is ·0000266 inch, from which we can calculate the vibrations.

These numbers are so enormous that one is apt to be sceptical as to their accuracy. Their computation is, however, extremely easy, and we are perfectly certain that they form very close approximations to the truth.

By screwing two plates of glass together, the rays of light pass through the first, and are refracted by the second, and when received on white paper, exhibit the fits of Newton, consisting of alternate light and dark colours. A happy idea struck Dr. Ritchie on the morning previous to his lecture, that by a modification of this principle, Newton's rings might be exhibited. He accordingly screwed together two plates of glass, divided at their margins merely by a layer of gold leaf, directing the pressure upon one central point with the extremity of the screw, around which were beautifully displayed the rings as he had anticipated. These may be enlarged by additional pressure near their circumference. In this way these can be measured, and the above numbers deduced. Frenelle, by means of ingenious apparatus, has been enabled to exhibit the length of the waves, and measure them by means of a microscope. His results were the same as those given. Dr. Ritchie considers that the experiments of Frenelle prove conclusively that light consists of the undulations of a fluid, interfering with each other and producing darkness.

A further proof in favour of the theory is, that when light is passed through a small aperture, by reflexion, we have, if we place a sheet of paper opposite to the hole, alternations of red and dark colours, and M. Arago has shewn that light moves more slowly through glass than air. M. Colladon, by some very interesting experiments at the lake of Geneva, has proved that with sound as with light, the angle of incidence is equal to the angle of reflexion. Newton objected that if light, like sound, consisted of waves, sound ought to have a shadow. Now, the fact is that when sound passes very rapidly we have a kind of shadow of sound. When two tuning forks are set differently, we have one sound ascending and the other descending, affording a strong similarity to the inference of undulations. When light is polarized, as by Iceland spar, if we cause two portions to act upon the same plane, alternations of dark and light colours are obtained, shewing interference of waves; but when these portions act at right angles no such interference takes place. When light passes through a gas, and when we examine the spectrum, we observe dark spaces, which may be occasioned by one wave interfering with another. Light from the sun does not possess polarized properties which light from a hot iron does, shewing that light is derived from the sun's atmosphere, and not from the substance of that luminary, because, in the latter case, there would be a gradual diminution of its size. A strong argument in favour of the undulatory theory is derived from a recent experiment of Mr. Faraday, who found, by the action of electricity, that as much light was given out from a copper wire in the course of a few days as could be emitted from the sun in a year. Is it possible to suppose that this enormous quantity of light existed pent up in substantial form in the wire? Dr. Ritchie gives his decided negative to such an opinion, but is inclined to infer that the light which enables us to see exists within ourselves, as the heat which warms us is contained within us.

A LEARNED DISQUISITION ON AN ANCIENT RELIC.

By Mr. Landseer.

13th February.

M. Landseer read a very learned disquisition on a monument, of which a cast was brought to this country by Mr. Joseph Benomi, who has recently published travels in the East. The original of this ancient relic exists along with nine others on the sea shore near the river Lycus, two hours journey from Bayrroot. With the exception of this one of which the cast was exhibited to the meeting, by permission of Lord Prudhoe, the monuments are much defaced.

They were probably seen by Herodotus, for he describes similar relics in Ionia. Maundrell saw them in 1767, and describes them with great accuracy. Benomi is the only other modern traveller who has been fortunate enough to fall in with them. He, in the most praiseworthy manner, undertook the labour of making a cast of the most perfect one, instead of carrying off the original in the way too often practised by eastern visitors.

It appears to relate to Sesostris or Rameses II., who lived, according to Dr. Pritchard, 1007 years from the commencement of the Egyptian era. The principal feature in it is the figure of a monarch, with a sceptre in one hand, and a dove in the other, of which, however, only the tail remains. The dove was the standard of the Assyrians, hence, in the Bible it is represented as an oppressor. Over the dove

are 7 orbs, which are the seven stars, the pleiades, the Succoth penneth, or tents of the daughters in Scripture, called genial and exhibiting stars, and are shedding their influence over the dove.

The face of the monarch is towards the east, and the stars are placed on the east of the monument, rising with Aldebaran. Two larger orbs represent the sun and moon, supplied with wings similar to the sculptures of Persepolis. There is still another star which is probably Venus, the morning star. Mr. Landseer from these and similar data, concludes that this monument was sculptured in the time of Pelassar or Salmanassar, twenty-five centuries ago. Another monument of which a drawing by Benomi was exhibited, contains on its margin the hieroglyphical name of Sesostris, identical with that which exists on the table of Abydos. The sculpture represents the figure of a man holding a bow in his right hand and a battle-axe in his left, in the act of offering prisoners to a deity. Herodotus describes an Ionian monument almost identical with this. Another of the monuments observed near Sidon, relates the circumstance of Antoninus having altered the road along the coast, the former road having been at a greater elevation.

In the course of his lecture, Mr. Landseer displayed an intimate acquaintance with sacred and profane history, and shewed that his mind was keenly alive to the refinements of literature. In some of the poetic flights in which he frequently indulged, we were brought back to those ancient times, when the kindly influences of the heavenly orbs presided over human destinies, and the descriptions might have almost induced the sanguine to regret, that such mysterious days have passed away.

AN ABSTRACT OF SOME RESEARCHES ON THE REPULSION PRODUCED BETWEEN BODIES BY THE ACTION OF HEAT WITH ADDITIONAL OBSERVATIONS.

By the Reverend Baden Powell,
M. A., F. R. S.,
Savilian Professor of Geometry, Oxford.

The curious point to which my attention has been directed, is one of those which too generally fail in securing the attention of philosophers, from the circumstance that they belong to a class of phenomena hardly coming within the specific range of any one of the great divisions of Science; or rather, belonging equally to several, are but little considered in any. In the "Records of General Science," however, some account of them may perhaps find a place.

At the meeting of the British Association at Edinburgh, I gave a short statement of the experiments which I had made: an account of them was also read before the Royal Society, and is now printed in the Philosophical Transactions for 1834. But a brief outline of their nature and object may not be unacceptable to some readers, especially as it will be essential to render intelligible the further observations I wish to add.

The expansion of bodies by heat seems to imply a mutual repulsion of their particles; and it is a question naturally suggested, whether such a power of repulsion may not generally belong to heat, or be excited by it between particles or masses of matter at sensible as well as insensible distances. But, however obvious the suggestion of such an inquiry, it is of a nature not easy to be pursued or decided.

The subject has been partially investigated by Sig. Libri, and by M. M. Fresnel and Saigey; but their researches do not appear to have been regarded as decisive, and have ever been viewed with considerable doubt; and they are certainly dependant upon experiments of the most extremely delicate and difficult kind, and those of Fresnel confessedly left in an incomplete state.

Recently, the inquiry has been revived by Professor Forbes of Edinburgh, who has referred to the same principle to account for the singular phenomena of certain vibrations of heated metallic bars, first noticed by Mr. Trevelyan, and since fully investigated by himself in a paper in the *Edinb. Trans.* vol. xii.

In a different form the subject had occupied my attention before I was acquainted with Professor Forbes's investigations; but, on reading his paper, a new interest attached to the inquiry, and in pursuing it, I conceive I have obtained some results which appear decisive on a question at once of importance in the analogies of physical action, and which has hitherto been regarded as at least involved in considerable uncertainty.

The method I pursued was that of forming Newton's rings between lenses, and applying heat, which would afford a simple mode of deciding the question, if there be any separation of the glasses by repulsion, since it would be rendered visible by the *contraction of the rings*. As to the error which might arise from the *warping* of the upper glass by the heat, it will be evident, on a little consideration, that heat applied outside of either glass will tend, by the change of figure, in every case, the first instance, to *diminish* the angle of contact: that is, if no other cause interfere, to make the rings *enlarge* without altering the central tint, until the curvature become equal to that of the convex surface.

I invariably found, however, that *from the first moment the rings regularly contract, and the central tint descends in the scale till the whole vanishes.* There are, however, several precautions necessary to be attended to. If the glasses be more than very slightly convex, the portion of surface throughout, which they approach sufficiently near for the repulsion to act, is very small. This may render the total effect far too weak to overcome the weight of the upper glass, or even its inertia, though placed vertically. With surfaces of such curvature as to give the first bright ring a diameter of about 0·3 inch, on placing a red hot poker a little above the glasses the effect never failed to be produced. Upon the whole, the ex-

periments, though simple in principle, certainly require some care; but with all precautions, and after the most careful consideration of all causes which can have tended to produce or effect the result, it appears to me that the separation of the glasses through the extremely small, but finite and known spaces, whose changes are indicted by the degradation of the tints, can only be due to *the real action of a repulsive power, produced or excited between the surfaces of the glasses by the action of heat.*

There are many questions relating to the nature and properties of this repulsive power, which are immediately suggested, and some of which appear capable of solution by variations of the same method.

The *distance* at which the repulsive power can act, is shown by these experiments, to extend beyond that at which the most extreme visible order of Newton's tints is formed. But I have also repeated the experiment successfully with the colours formed under the base of a prism placed upon a lens of very small convexity; and according to the analysis of these colours given by Sir J. Herschel, (On Light, 64,) the distance is here about the 1,100th of an inch.

Beyond these very small distances, other methods must be resorted to. But the certainty of the result within these limits perhaps confirms its probability at greater distances, as inferred by Fresnel and Saigey.

I tried several experiments on the effects of different sorts of surfaces, from which I conceive, though we may infer that *cæteris paribus*, the better radiating power of the surface increases the effect; yet there are other circumstances which affect the result more powerfully, and these seem to be, in general, *whatever may tend to the more rapid communication of heat.*

This is still more conspicuous when the rings are formed in a thin plate of *water* between the lenses. The effect is here even greater than in air, and we may presume, independent of *radiation*.

There are several subordinate circumstances attending these results which are deserving of notice. When the lenses are in close contact, there is, in all cases, a considerable attraction opposed to the repulsive power. If the central black be formed, it requires a very considerable intensity of heat to overcome the attraction, which at that minute distance is extremely powerful.

When the heat is removed the colours return, and the rings are gradually restored to the same character as they had at first. This is more remarkable when simple plates of glass are employed as before described. When the heat has restored the bent glass to a plane figure, on its removal the rings return, and consequently, the glass is again bent without any fresh pressure, though the force originally applied to produce the curvature was very considerable; this is probably owing, in a great measure, to atmospheric pressure. In this case, however, the colours will only return up to a certain point, generally not higher than the beginning of the first order.

When two glasses are pressed together there is a repulsion to be overcome, evinced by the force which it is necessary to apply, and in general, it is evident, that if a plate resting on another be bent by pressure, as in these experiments, the influence of heat in restoring it to a plane form will be opposed both by the attraction at the centre, which tends to prevent that part from being raised, and by the repulsion towards the exterior parts, which tends to prevent them from being depressed. When the curvature begins to change, therefore, there is somewhere between them a neutral or nodal point whose position does not change; this point may be very near, or even in the centre, when the attraction is very strong there. A remarkable instance of this occurs when the first black of the scale is formed between glass plates, and heat carefully applied exactly over the central point of the black space; in this case, when the black space is a $\frac{1}{4}$ inch or more in diameter, I have often continued the application of the strongest heat for a great length of time before any separation could be effected, when at length it has taken place with a sudden force and an audible click. Sometimes the black spot has continued unaltered until the glasses have cracked, when the fragments have still continued to adhere powerfully: meanwhile the outer rings have continued gradually *enlarging*.

In the foregoing statement, I have observed, that in using plane glasses, it was necessary to allow for the effect of *warping*. But there are certain considerations which show that that precaution is unnecessary. For, according to the beautiful experiments of Sir D. Brewster on the progress of heat through glass, as evinced by its action on polarized light, it appears distinctly, that the change of structure (if I may so speak) in the molecules of the glass is produced *at the same instant*, on *both* sides of the plate: so that the effect of *warping* cannot take place. This is rendered evident to the eye, by the symmetrical arrangement of the luminous bands, from the first moment of the application of heat, on each side of the dark *central* band, which occupies the neutral line along the middle of the thickness of the glass.

When two plates of glass are laid upon one another there is a certain resistance or repulsion which may be overcome by pressure. We can press them together till attraction takes place. On removing the pressure they remain adhering. If we press them more they are brought closer, and produce the colours of thin plates. We may thus produce successively and given tint, and on removing the pressure that tint will remain, or the glasses continue in the same position to which they have been brought.

This seems to show that the attraction and repulsion are in exact equilibrio at all distances, (within this range,) and this may hold good with any *law*, provided the law be the *same* for attraction as for repulsion.

On the application of heat a greater intensity of repulsion is excited; if we could ascertain the law of its increase with the distance

and increase of temperature, we might thence infer the law both of attraction and repulsion between the *surfaces*; and thence, (if the expression be integrable,) that between the *molecules* of the substances.

All this, as just observed, takes place only within a certain range of interval. When the central black is formed, we seem to have arrived at a limit where attraction prevails; and where the application, even of great heat, will not easily overcome it.

The close contact of a glass and liquid in capillary attraction appears to be within this limit; for here, in several cases referred to in my paper, it appears that no application of heat can overcome the attraction.

With respect to one of those experiments, viz; that of Sig. Libri, which I had stated I could not succeed in repeating, I have since been informed that the experiment *will* succeed, provided the heat applied to the wire be that of a flame urged by a blowpipe. This, at any rate, proves the great intensity of the attraction, which requires so extremely high a degree of heat to overcome it.

Oxford, Feb. 17, 1835.

INSTANCES OF SPONTANEOUS COMBUSTION, DETAILED IN A PAPER READ BEFORE THE ROYAL IRISH ACADEMY.

25*th May*, 1835.

By M. Scanlan, Esq.*

In the beginning of last March a fire broke out in the extensive turpentine distillery on Sir John Rogerson's quay, belonging to Mr. John Fish Murphy, which is seperated from my chemical factory by Windmill Lane. The fire, which was speedily got under, was confined to a heap of what is termed, by turpentine distillers, chip cake, and, from the circumstances under which it occurred, could not be attributed to any other cause than the act of an incendiary, or to the spontaneous ignition of this chip cake.

As spontaneous combustion of this substance had never occurred before in Mr. Murphy's distillery, nor in that of his father an extensive distiller of turpentine, for many years, at Stratford in Essex, I at first doubted that the fire could have originated in this way; however, on inquiry, I found his mode of working had been, on this particular occasion, different from that usually employed in his distillery, and, experiments which he kindly permitted me to make have since proved beyond doubt that combustion did take place spontaneously.

Raw turpentine, as it comes from America, in barrels, includes a considerable quantity of impurity, consisting of chips of wood, leaves, and leaf stalks.† It was hitherto the practice, in Mr. Murphy's distillery, as it is in England, to heat the raw turpentine up to a temperature of about 180°, as I found by plunging a thermometer into one of his large copper pans, and to strain the turpentine, thus liquified, from the impurities, previously to introducing it into the still, where it is submitted to distillation in the usual way, with a portion of a water, yielding turpentine oil, which distills over along with the water and rosin which remains behind in the still. The chips, when separated by a wire strainer, still retain a quantity of adhering turpentine worth saving, and with this view are transferred to a large close vat, where they are exposed for some time to the action of steam furnished by a boiler kept for this purpose, as well as for steaming the empty barrels, in order to remove any turpentine that may adhere to them. Still, however, the chips are a good deal imbued with resinous matter, and in this state form a loose porous mass, which the turpentine distillers call chip cake, a material which is used by the poor in the neighbourhood as fuel.

As long as the process I have just described was pursued, which is the London mode, and that which produces the best rosin, no accident occurred from fire in Mr. Murphy's premises, although I have frequently seen immense heaps of this chip cake collected together in his yard; but, on making trial of a different plan, namely, that practised by a Dublin distiller, Mr. Price of Lincoln Lane, the accident in question occurred.

On this occasion, the raw turpentine, together with its impurities, was put directly into the still, along with the proper quantity of water, and the boiling rosin at the end of the operation strained from the chips.

The chip cake resulting from a single operation thus conducted was laid in a heap outside the still house, at three o'clock in the afternoon, and at midnight was observed to be in flames.

In the first mentioned process it is obvious the chips were never exposed to a higher degree of temperature than 212°; but in the latter, especially when it is the object of the manufacturer to make amber rosin, the temperature to which they are exposed is much higher.

The first experiment I made was on the 16th March. I found the temperature of the boiling rosin, in the still, to be 2500 when the turpentine oil and water had been distilled off, the fire just drawn from under the still, and when the liquid rosin was in the act of being strained from the chips which were introduced into the still with the turpentine.

I had the whole of the chip cake resulting from this distillation carried into my own yard, upon a wire screen, and left in the open air, with a view of watching its progress.

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* Communicated by the Author.

† The following extract from the letter of a French turpentine merchant, will account for the presence of these foreign bodies. To obtain the turpentine "the fir timber is chopped about a man's height down its side with an axe, not hand deep and afterwards higher up. The turpentine or *rosin pat* is scraped up from the foot of the tree. That which is on the side wound, when scraped off, is white, and called *galley pat*, of which the burning incense is made. It does not yield so much turpentine spirit as the *pat*."—Edit.

The temperature increased gradually in the centre of the heap, although externally it became quite cold and brittle. In four hours, in fact, a thermometer thrust into the centre of the *porous* mass indicated a temperature of 400°; a good deal of vapour was now given off, and the adhering rosin in the heated parts began to acquire a high colour; the smell could be perceived at a considerable distance from my premises; it was a mixed smell of pitch and rosin.

The chip cake, in this experiment, was first exposed to the air at one o'clock in the afternoon, and, though it rained during the night, at half-past eleven the following morning it burst into a flame.

In a second experiment, I placed the chip cake in an open tar barrel, having three holes bored in the bottom, about two inches diameter each, and it did not take fire till the expiration of thirty six hours; but the temperature of the mass was lowered by removal from the wire strainer to the barrel, and besides, I am of opinion the limited access of air retarded the combustion.

In a third trial which I made, combustion took place in five hours; but in this experiment the temperature of the boiling rosin drawn from the still was 260°, and the chip cake was laid, as in the first experiment, on the wire screen; the wind, too, was very high. The screen, in this case, was raised a few inches from the ground, in order to let the rosin, as it melted, drip away, which it did in abundance.

It appeared to me as if the porous mass became slowly red hot, in the centre, like a pyrophorous, and as if the vapour and gaseous matter arising from the decomposed rosin which lay immediately beneath, were inflamed on coming in contact with it. I was standing by when it suddenly burst into flame, and I thought, at the time, had the melted rozin been permitted to drop into water, or had it fallen to such a distance as not to be kept liquid by the radiant heat from the red hot mass above, that there would have been no flame, but silent combustion.

I have since learned from Mr. Price, in whose distillery it has always been the practice to put the unstrained turpentine into the still that he was well aware of the fact which it is the object of this paper to record, from a fire having occurred several years ago on his premises, when in the possession of his predecessor, Mr. James Price, and that, ever since, they cool down the chip cake, immediately on removal from the still, with water, and afterwards use it as fuel under the still.

An instance of spontaneous combustion occurred with my friend Mr. Philip Coffey, of the Dock Distillery, which is worth relating while on this subject.

He had made a quantity of the mixture used in theatres for producing red light, a powder consisting of nitrate of strontion, sulphur, chlorate of potash, and sulphuret of antimony with a little lamp black. A paper parcel of this "red fire," of about a pound or two by weight, was left by him on a shelf in a store-room where there was no fire nor candle lights; the following day, while reading in an adjoining room, he perceived a smell as if some of this powder were burning, and, on examination, he found it had ignited spontaneously on the shelf and was actually consumed.

M. SCANLAN.

Sir John Rogerson's Quay, Dublin, 29th June, 1835.

ON AN EASY METHOD OF MEASURING PRISMATIC SPECTRA.

By Mr. Andrew Pritchard.

It may be questioned whether any important discovery relating to the prismatic spectrum formed by decomposing common light, has been announced, since that of its heterogeneous nature by the illustrious Newton, with the exception of the synchronical detection by Wollaston and Fraunhofer, of the constant dark lines which were found in every instance, to maintain a fixed and determinate distance from each other.

The actual measurements and relative extents of the intervening spaces, may thus be considered as important data; and any contrivance, however simple, for determining their exact places, will be, it is presumed, acceptible to the practical observer. I therefore propose to describe a very facile method of effecting this purpose, prefixing a brief account of Fraunhofer's telescope for viewing and examining the spectrum. This telescope has a small achromatic object glass close before which is placed a short prism, one side of it making a small angle with the axis of the instrument. For viewing the image a positive eyepiece is employed, producing a magnifying power of between twenty and thirty times. In other respects it resembles a small astronomical telescope, having however a much longer range of adjustment, so as to render the image of a near object distinct. Now the method employed by me of obtaining the measurement, consists simply in the addition of a circular glass micrometer, placed at the focus of the object glass, it being obvious to every person acquainted with a telescope, that a series of equal divisions placed in the plane of the focus of the eye-glass, will measure the relative distances occurring between the several dark lines in the spectrum, the places of greatest intensity of the different tints, or any other phenomena that may present themselves. By drawing equi-distant and similar lines upon paper, the image presented by the spectrum may be laid down with the greatest accuracy, or indeed when the colours are sufficiently vivid, they may at once be thrown on the paper by a camera lucida eye-piece.

The micometers used by me are discs of glass, with from 50 to 100 divisions to the inch, and are similar in construction to those employed with my microscopes, except in the omission of the cross lines which are drawn upon the surface of the latter.

263 *Strand, near Temple Bar, June.—Records General Science*, 1835.

PURIFICATION OF PYROLIGNEOUS ACID AND MANUFACTURE OF ACETATE OF LIME, ACCORDING TO THE METHOD ADOPTED BY CHEMICAL MANUFACTURE.

By Chr. Phil. Pruckner, of Hof.*

INTRODUCTION.—From his first connexion with the manufacture of pyroligneous acid, which has been on a great scale, Prückner endeavoured to fall upon the cheapest and quickest method of purifying it from the foreign matter with which it is mixed. This object has been further prosecuted more recently by Dr. Reichenbach, who has separated several substances which make their appearance during its purification.

At the time when Prückner first engaged in the manufacture of this acid, these substances were unknown, and, consequently his view of the theory of the method of obtaining it pure, was quite different from that pointed out by Reichenbach. Now, however, when we possess an accurate knowledge of the products which come over in the purification, viz. *Creosote Picamare, Paraffin*, &c., we may expect that the process about to be discribed will be improved, so that the last traces of foreign matter may be entirely removed. The author considers that the present memoir will not be destitude of interest for a considerable period to the practical chemist, as the process discribed has been so frequently repeated and examined, and that the publication will be of advantage to proprietors and managers of chemical manufactories, who may, from the remarks offered, be enabled to improve the process, by bringing the additional information which may be acquired by the consideration of new discoveries, to bear upon the subject.

Many manufacturing chemists have long been endeavouring to purify pyroligneous acid in different ways. The process of Mollerat of Pellerey, who, by the formation of a great chemical manufactory of this article, not only supplies it for the use of France, but also exports it, is sufficiently well known. It consists in forming the acetate of soda by the double decomposition of acetate of lime and sulphate of soda; the acetate of soda being then roasted, the empyreumatic matter is driven off and the pure acetate of soda remains. The objection to the use of this salt is, that at an elevated temperature it melts, and that the surface of it gradually becomes dry, while in the interior much water still exist, and great difficulty is experienced in getting rid of it, while to the acetate of lime the same objection is not applicable.

PREPARATION OF THE ACETATE OF LIME.—The crude pyroligneous acid which is distilled from hard species of trees, as the beech, oak, or alder, or from soft pines, receives a preparatory purification in the following manner:—As much as possible of the oil mixed with tar which swims on the surface is removed mechanically. This is best effected after the acid has been allowed to settle for a day. A cask or large tub, with a double perforated inlaid bottom (einlegeboden) like the alkaline cask of the soap-boiler, is then taken and filled to the height of an inch with straw. This is overlaid by a piece of course sack-cloth, which is cut out in the form of the bottom. Over this is placed six inches of moist wood sawings, which are pressed down and smothed by means of a wooden club. To prevent the sawings from being displaced and from swimming about, they are covered to the depth of four inches with a layer of gravel. A certain quantity of impure acid is then poured into this filtering apparatus which is termed a filtering cask, and passing through is discharged by a cock at the bottom. The tar is taken up by the gravel. Should the quantity of this be so great as to obstruct the passage of the acid, the sand may be stirred up from above with a ladle.

The acid which has thus been filtered is now placed in a large cast-iron vessel, which is filled up to within ten inches of the brim. Heat is then applied, and during its action, lime-water previously passed through a hair seive, to free it from foreign particles, is added until the acid is neutralized. The approach to this point may be detected without the use of litmus paper, merely from the colour of the liquid, which becomes darker and passes from a blackish brown into a deep brownish red colour. A great excess of lime is then added. To a bucket of neutralized acid, containing 120 pounds (115lbs. troy) half a pound, (.479lbs. troy) is added in excess. This super-saturation is absolutely necessary; because the lime combines with a great quantity of empyreumatic rosin and oily matter in the acid, forming insoluble compounds which are separated first. The next object is to bring the solution to the boiling point, and to avoid its boiling over. When a scum appears, the boiling should be carried on gently, and the matter swimming on the surface removed, as completely as possible, by means of a ladle during the whole process of boiling. The solution in this manner being reduced to one half, is then cooled and clarified in the cask and allowed to stand for 30 or 48 hours. In this state it is called the solution of the first boiling.

To obtain the solution of the second boiling after the necessary clarification, the liquid is drawn off into the same vessel after it has been cleaned, or into another iron vessel of the same description. The sediment is thrown upon a filtering cloth and set aside. For the second evaporation a shallow vessel is employed, whose depth is not above 14 inches. Prückner uses a vessel of 4 or 5 feet long and 2 to 3 broad as being most convenient. The fire burns under it, upon the grate of a wind furnace, and stretches under the bottom of the vessel towards the chimney. When the solution of the second boiling is heated, the free lime must be neutralized with pyroligneous acid as long as reddened litmus paper is coloured blue. When evaporated to two-thirds or one half, the solution may be freed from any impurities by passing it through a linen filterer, or placing it in a cask and allowing it to cool and settle.

The liquid having been treated in this way, should be again placed in the flat vessel, and by

* Erdmann und Schweigger-Seidel's Journal für Practische Chemie, iv. 21.

a gentle heat evaporated to a mass, which while warm, should possess the consistence of thick turpentine, and after cooling should not stick to the fingers, but should rather crumble down when pressed. Considerable care is necessary towards the end of this process. When the solution is beginning to become thick it must be stirred with a curved iron spatula, of such a length, that it may extend over the whole vessel, in order to prevent the salt mass from being burned.

The acetate of lime now half dry, is transferred from the evaporating vessel to a stone or iron plate, and spread by means of the spatula to the depth of 2 or 3 inches, for the purpose of cooling. It should not remain so long as to attract much moisture, but should speedily be subjected to the last operation, the drying and roasting of the salt.

The drying furnace is a simple wind furnace, 7 or 8 feet long, $4\frac{1}{2}$ to 5 feet broad, built of brick; at 6 inches above the ground is the ash-pit, 8 inches broad and 12 inches high, which is covered with a grate of bricks. The fire-place is 20 inches high and 10 inches broad at the grate; over it is an arch of bricks, so that the fire cannot play on and heat very highly, the iron drying plate lying on the side of the hearth. The space below the drying plate is separated from the hearth, by a partition of bricks 3 or 4 inches high; 12 inches above the outlet of the earth there is a layer of iron bars $1\frac{1}{2}$ to 2 feet from each other, and upon these is deposited the drying plate. This consists of cast-iron $\frac{1}{4}$ of an inch thick, and is formed according to the size of the furnace. Round the plate the furnace is built up to the height of 10 inches, on the side of the front wall, leaving room for doors, which may be calculated at $2\frac{1}{2}$ feet. These doors are two, one above the other, through which the whole interior of the furnace can be inspected. They are formed of plate-iron, and have in their middle a sliding door to admit of the exit of the vapour from the acetate of lime and of some ventilation. A wall built at the end of the plate or a clay partition separates the whole of the drying plate from the chimney. In the walls of the furnace, iron-bars are fixed, and upon these lies a second drying plate which covers the drying space. This plate as it does not come in contact with the fire may consist of good iron or of clay.

Above this drying space another is formed by means of the chimney. The heat passes as well under as above the drying space, and passes into the chimney, which is situated at the side of the furnace, and can be shut by a valve. In the drying space the temperature is usually between 60° and 90° R. (167° to $234\frac{1}{2}$° F.)

Turf forms the best material for fuel, as it does not burn rapidly, and produces a steady and equal temperature.

DRYING OF THE ACETATE OF LIME.—When the furnace is thoroughly and equally heated, the flame of the fire is allowed to subside. If wood is employed as fuel, the sliding door should be opened at the commencement, in order to allow the moisture to escape. The salt is transferred from the evaporating vessel to the drying plate, and spread out to the depth of two inches; and, after the first portion has become somewhat dry, the depth is increased to four or five inches; the heat is preserved at the degree already mentioned for twenty-four hours, and during this time the salt is turned several times. Subsequently, when the mass appears to be becoming dry, the temperature may be increased to 100° (257°F.) so as to dry it completely. The mass is dry and properly roasted when it possesses the following characters: It must, before cooling, be brittle, easily crumbled between the fingers, mixed with blackish carbonaceous points or streaks, between which appear white pieces of dry salt, a solution of the comminuted salt; in four or six times its volume of hot water possesses a yellowish brown colour with a dark tinge, while previously it had a reddish brown colour.

When the heat is increased towards the end of the process, as described, care must be taken to do it gradually, so that no smoke shall rise from the acetate, because it might thus be decomposed. Neither must any spark be permitted to come in contact with the acetate of lime; because, like sugar of lead, it possesses the property, in these circumstances, of catching fire and burning, by which the whole dry preparation would be completely destroyed. The treatment of the acetate of lime in this manner, by means of gradual drying, as experience has shewn, possesses many advantages over the method of drying the salt in an open vessel, because there is no loss of acetic acid, as always occurs by the latter process. The operator has the preparation completely in his power, and with little expense of fuel and time, many hundred weights of salt can be prepared at once.

This process does not merely extend the removal of the moisture from the acetate of lime, but a chemical influence is exerted by means of it. Because, it is certain that the substances formed by dry distillation, which have been recently distinguished by Reichenbach, are partly dissipated by the heat, and partly decomposed; the acetate of lime possessing very different properties before and after the process. After the process the salt does not imbibe water so readily as it did previously. After solution, filtration and evaporation, a much purer product is obtained than before, and upon the filter a resinous matter remains, the constituents of which have not yet been examined. After the completion of the previous steps the operator proceeds to the next, the

SEPARATION OF PURE PYROLIGNEOUS AND ACETIC ACID.—Into a cast iron retort, capable of holding 30 measures of water, (of 2 lbs. Vienna weight), introduce 20 lbs. (Vienna weight) of dry acetate of lime, and then 5 lbs. of water, and stir the mixture well up by means of a wooden spatula. This preparation should be made in the evening, and the mixture allowed to stand till the morning. On the following day 20 lbs. of English sulphuric acid, diluted with 5 lbs. of water should be added, and the cover of the retort cemented.

The cover should be made of pure tin, and united with a refrigatory, whose tube is also formed of the same metal. Prückner considers porcelain preferable to tin for the composition of the cover, or rough burned clay (*nicht durchswitzender*), the latter of which he himself employs.

To prevent the melting of the tin, when that metal is employed, it is necessary to separate it from the iron of the retort by means of a stripe of linen; a luting of lime and fine sand then serves to unite the cover and belly of the retort. Larger retorts are not desirable, because, towards the end of the distillation, decomposition of the acetic acid is readily produced, in consequence of the destruction which a portion of the mass in contact with the bottom undergoes, while all the acid contained in it is driven off. The distillation begins with a gentle fire, and should be carried on without increasing the heat, until the liquid passing over begins to produce a yellowish colour in the distilled liquid. It is not worth while to obtain the last portions of the acid, because the educt is impure, and sulphur begins soon to sublime.

From the 25lbs. of acetate of lime are obtained 25 to 27 parts of acid. The gypsum remaining in the retort can be easily removed. It contains some free acid, which may be washed out and preserved for further use. By the action of the sulphuric acid upon the acetate of lime, a sulphurous smell will be perceived, which also exists in the weak acid which passes over first. This arises from a partial decomposition of the sulphuric acid, in consequence of which sulphurous acid is disengaged.

To diminish, as much as possible, the quantity of this in the whole distilled liquid, the first tenth is removed. The subsequent distillation is continued until the liquor passing over begins to lose its pure water colour. The last portions will, therefore, be separated and mixed with the acid which passed over first, for the purpose of being further purified.

The acid obtained in the manner described, possesses generally the specific gravity of 1·045—1·050, is colourless, like water, and retains still a trace of the original empyreumatic odour.

It contains also some sulphurous acid, and possesses corresponding characters, but loses it after being exposed for some time to the air, in open vessels, the acid being converted into sulphuric acid.

It is obvious, from the quantity of acid recommended, that, for the decomposition of the acetate of lime, an excess of sulphuric acid is necessary; since, for 100 parts of dry salts, 62 parts of acid, excluding stechiometrical quantities, would be sufficient. The peculiarity of Prückner's process, he considers to consist in these proportions; and he has found that the addition of the excess of sulphuric acid is the most powerful method of destroying or decomposing the empyreumatic matter existing in the pyroligneous acid. In consequence of inattention to this circumstance, the methods of purification pointed out by several chemists, especially that of B. Stolze, in his work, "Gründliche anleitung die rohe Holzäure zu reinigen," &c., must be either useless or very inefficient. The method of previously heating the acetate of lime, and of abolishing the drying in an open vessel, over a free fire, is a decided improvement. For thus, there is an inconsiderable, or no loss by the decomposition of the acetate of lime, with the least possible waste of time and fuel. For manufacturing purposes, as for making acetate of lead, and acetate of copper, there is no need of repeated distillation, because the sulphurous and sulphuric acid can readily be separated in the following manner: A quantity of liquid disacetate of lead is to be prepared, to about a pound of which the distilled acid is to be added, until no more precipitate of sulphate of lead falls. The latter should be collected and weighed. The quantity of sulphuric acid in a given quantity of the acid, being thus known, it is easy to calculate how much of the acetate of lead solution will be required to throw down the whole acid in the acetic acid. Some sulphate of lead is held in solution, which is of little consequence in the manufacture of sugar of lead.

FURTHER PURIFICATION OF THE PYROLIGNEOUS ACID.—For chemical and pharmaceutical purposes, it is necessary to have pure concentrated acetic acid. To accomplish this the sulphurous acid in the distilled acetic acid should be digested for a short time with finely pulverized brown-stone, and a little wood or animal charcoal. One pound of brownstone and ½ pound of animal charcoal are sufficient for from 25 to 36 lbs. of acid.

The supernatant liquid after the precipitate has been allowed to subside during 12 hours should be decanted off, transferred into a retort and rectified by a second distillation to dryness. The acid passes over pure and colourless, and destitute of any smell, save of acetic acid, having a specific gravity of from 1·042 to 1·049, or 7° or 8° by Beck's areometer, and may be used for all chemical purposes. According to the custom of the trade, and of the French manufacturers, a portion of acetic ether may be added to the acid, by which mixture the smell becomes more pleasant.

Supplement.—According to A. Richter, chemical manufacturer at Königssaal, in Bohemia, with whom Prückner corresponded on this subject, it appears, that when the pure acid, obtained by the process described, is neutralized by carbonate of potash, and then some strong potash lye is added, it still retains a yellow colour, from the presence of an oxydizable body, of which it is difficult to free the acid. Prückner, during the course of last summer, in his researches, fell upon a method of affecting the separation of this substance.

Pyroligneous acid is not precipitated by infusion of galls, and even after some time nothing falls. If however tincture or infusion of galls be poured into a solution of pyroligneous acid salt, as of raw acetate of lime (or acetate of potash) a dark reddish purple precipitate subsides, which contains a salt of tannic acid. The previously blackish brown liquid becomes, clearer and transparent like Rhenish wine, and leaves after filtration and evaporation to dryness, by being placed for several days in a temperature of 70° or 80° R. 189° or 212° F.)

a mass of salt, which, when compared with the original salt, appears much lighter coloured. If this is dissolved in water, or if the filtered liquid before filtration is treated with some animal charcoal, the colour of the salt becomes still lighter, and the odour is removed. This salt of lime being diluted with $\frac{3}{4}$ of sulphuric acid and as much water, after distillation carried nearly to dryness, and digestion with black oxide of manganese and re-distillation, afforded an acid of specific gravity 1·060. This acid when neutralized with a solution of carbonate of potash, and the addition of some pure colourless potash lye, acquires no colour, and continued in this state for several weeks. As the expense of the galls would be considerable, Prückner recommends as a substitute, a decoction of oak bark, which he found to afford a precipitate, or a decoction of the fallen catkins of the common alder (*Alnus glutinosa.*)—Records of General Science, 1835.

PHYSIOLOGY OF MAN.

ON THE EXTERNAL CONFIGURATION AND INTERNAL AGGREGATION.

(*Continued from page* 16.)

XXVI. Some bodies, the solids, fill space in a durable and uniform manner, whilst others, the liquids, vary in their manner of filling it. These, air and water, are the vehicles which contain the solid bodies. All organic bodies, as also all minerals, mercury excepted, are solid. Organic bodies at the same time have a regular form, which minerals only present in the state of crystallization. In comparing these two groups of bodies, in reference to their configuration and aggregation, we are under the necessity of confining ourselves, as far as minerals are concerned, to those which are possessed of a regular form.

XXVII. All organic bodies, plants as well as animals, have a form more or less round and oval, or branched and articulated, and they are confined by curved or undulating lines, as also by convex or concave surfaces.* Inorganic bodies, on the contrary, in cases where they have a regular form, as in crystals, are limited by flat surfaces and right lines by the conjection of which, at certain inclinations, are produced ridges and angles. This has been sufficiently demonstrated by Romé de l'Isle,† Bergmann,‡ but particularly by Haüy,* Brochant de Villiers,† and by others. It is known that crystals exhibit a great diversity of forms, both simple and complicated: these are cubes, hexaedrals, rhombs, prisms, columns,‡ &c.; but, however various their forms may be, it is possible notwithstanding, according to the connexion of their parts, to reduce them to certain primitive forms and to certain systems of crystallization.§ Thus these bodies, as was well remarked by Kielmeyer,|| represent in some degree the effect of an elementary geometry, whilst nature has employed a high geometry in proceeding to the formation of living bodies. It may be also said, and it amounts to the same thing, that the forms of organized bodies are more complicated than those of inorganic bodies.

XXVIII. The organic kingdom exhibits a much greater abundance and diversity of forms than that of the bodies not endued with life. The thousands of vegetable and animal species, showing so many differences in their configuration, are proofs of this. According to an estimate made some years ago by Humboldt,¶ there are known nearly fifty-six thousand species of plants, and fifty-one thousand seven hundred animals; but, since that period, besides a great number of new vegetables and animals have been discovered.

XXIX. If we compare living bodies with minerals in reference to their aggregation, we observe that, according to the expression of G. R. Treviranus,** organic bodies are distinguished both by the regularity and the heterogeneous nature of their parts, whilst the latter are possessed only of the first character and want the second. All living bodies, vegetables, and animals, are composed of heterogeneous parts. They always contain solid and liquid constituents, which is looked upon by Humboldt †† as a character essential to them. Besides, we remark in all, except the most simple, a vast number of heterogeneous components; in plants, we see roots, leaves, and flowers; in animals, muscles, nerves, vessels, bones, and viscera of several kinds. These parts, regularly arranged and distributed, are themselves composed of more simple parts; the tissues in organic bodies, on the contrary, are not the

* Several of the immediate organic principles are exceptions to this rule, inasmuch as, after having been taken from living bodies or secreted in them, they crystallize in different manners. Cholesterine, uric acid, and the sugar of milk are, in this respect, among those from the animal kingdom. Many vegetable substances, sugar, different acids, such as the pure sinapic, the benzoic, and others, but especially the salifiable vegetable bases, such as morphine, narcotine, strychnine, brucine, quinine, &c.; in fine the sub-resinous substances, crystallize. The forms of the latter are, however, for the most part, globular or radiated, like stars or rosettes, according to Bonastre, (Sur la forme cristalline de plusieurs sous-résines; in the Annales de la Societé Linnéene, de Paris, Nov. 1827, p. 549.

† Essais de Cristallographie, or, Description des Figures Géométriques propres aux differens Corps du regne Minéral. Paris, 1772, in 8vo.

‡ Ueber die Gestalten der Krystalle, 1773.

* Essai d'une Théorie sur la structure des Cristaux. Paris, 1784, in 8vo. Traité de Mineralogie. Paris, 1822.

† De la Cristallization Consideree Géomètriquement et Physiquement. Strasbourg, 1819, in 8vo.

‡ Whenever the operation of crystallization has been troubled, and the molecules are precipitated suddenly, the regular geometrical form is changed, and very frequently round forms are produced; but these, according to Haüy's very just remark, show a want of perfection in the mineral kingdom.

§ Weiss, in the Abbandlungen der Physikalischen Klasse der Akademie der Wissenschaften von Berlin, years 1814 and 1815, p. 289.

|| In his Course of Lectures on General Zoology.

¶ Annales de Chemie, vol. 16.

** Biologie, v. i, 158.

†† Aphorismen aus der Pflanzen. Physiologie, p. 33.

result of an assemblage of heterogenous parts, or if, sometimes, they present this character, the parts are only simply mixed with each other. Generally speaking, crystals are composed only of homogenous solid parts.*

XXX. Inasmuch as organic bodies are composed of liquids and solids, it follows as an immediate result, that they possess but little consistency and rigidity. All of them are soft and flexible, either throughout, or in a great number of their parts. In fact, their consistence varies considerably, as well in vegetables as in animals, and not only in the different groups of living bodies, but even in the different parts of each individual. In general, we remark that the more important parts of these bodies, those parts which perform the principal offices in the accomplishment of their special manifestations of activity, possess the smallest consistence and solidity, such as the fibres of the roots, the sap vessels, the alburnum, the leaves and flowers in plants; the nerves, brain, muscles, the viscera intended for the process of digestion, and of respiration, and those destined to the movement of the humours and to the different secretions in animals. The consistence varies also in proportion to the age. Regarding this, we may lay down the principle, that it is so much the more diminished in vegetable and animals, as those bodies are least distant from their origin, or from the periods of their development and growth, whilst it increases, together with the rigidity, in proportion as they approach the end of their career.

In organic bodies, on the contrary, which are composed entirely of solid parts, are remarkable for their great regidity. In them we do not see parts differing in point of consistence, neither does their rigidity vary with the duration of their existence.

XXXI. Another consequence of the mixture of the solids and fluids, which enter into the composition of living bodies, as well as of their state of softness, is the facility with which they undergo changes in the relations of their structure, that is, with which they move. These two very circumstances render their chemical composition more easily attacked by external influences, as of heat and the atmosphere, which act principally on their liquid parts. Minerals, which are composed of solids, and possess rigidity, do not exhibit these changes in the mutual connexion of their parts; that is to say, they do not move and are less liable to be varied in their composition by the action of exterior influences, particularly of heat and the atmosphere.

XXXII. All organic bodies do not only exist as a result of an assemblage of solid and liquid parts, but moreover this sort of constitution is indispensably necessary to their existence and preservation, inasmuch as it is the reaction of solid and liquid parts which determines and maintains the manifestations of activity or of life.* If the juices of a plant are abstracted, it dies; if the mass of its humours are withdrawn from an animal, and its vessels emptied of the blood contained in them, life is extinguished. Let the solid parts be destroyed in a mechanical or chemical manner, in this case too the manifestations of the life cease. It follows, then, that the solids and liquids of living bodies are in a continual reciprocity of action, indispensably necessary to the support of life.

XXXIII. Another cause, too, of the essential and necessary connexion which exists, in organized bodies, between the liquid and solid parts, is that the latter take their origin from the former. Every animal originates from a liquid, in the midst of which it is formed. Liquids, also, are incessantly furnishing the materials for the nutrition of the solids. These possess capability of exercising their manifestations of activity only so long as they are nourished. Every substance whatever which enters into organic bodies, under the name of food, should be liquid, or at least susceptible of becoming so. The solid, themselves are likewise resolved into liquids, in short, all matters which are elicited and rejected from living bodies, during life, are more or less liquid. But the constitution of the liquids depends, in its turn, on the manifestations of activity of the solids, for these are the chief source of the qualities which distinguish them.

XXXIV. Neither is it difficult to convince ourselves, by an attentive examination with the microscope, that the parts entering into the composition of organic bodies, are of another nature from those which constitute minerals. By this instrument we perceive, both in the liquids and solids of vegetables and animials, globular or oval, and occasionally flattened, bodies. The most simple animals, such as the infusoria, polypi, as well as the most simple plants, the confervæ, tremellæ, the pulverulent mushrooms, the byssus, &c., are composed of globules, as is

* The drops of water which are met with sometimes in crystals can scarcely be brought forward as an objection, because they are purely accidental. Thus Brewster (Transactions of the Royal Society of Edinburgh, vol. x. p. 1,) found colourless and transparent liquids in some topazes, in the chyrsoberyl, in the Quebec quarz, in the amethyst, &c. Commonly these liquids only in part filled the cavities of the crystals, and besides contained a bubble of air, which disappeared by the action of heat. Neither can the water of crystallization be objected, since it is intimately combined with the very matter of the crystals, and is not distributed in specified spaces, as the humours of living bodies are.

* Some vegetables and animals, of the most simple species however, for instance, mosses, infusoria, ratifera, *(vorticella rotatoria)* vibriones, *(vibrio anguilla)* &c., survive for some time the loss of their liquid parts; they may be dissected so as to give no sign of life, and when afterwards they are moistened, the phenomena of life are again roused in them, as is shown by the experiments of Needham, (Nouvelles decouvertes faites avec le Microscope. Leyden 1744,) of Baker, (Employment for the Microscope, London, 1764.) of Spallanzani, (Observations sur les Animaux qu'on peut tuer et ressusciter à son grê; in Opuscules de Physique, vol. ii, p. 261,) and of Foutana, (Sur le venin de la vipère, vol. i.)

shown from the results of Trembley's,*Schoeffer's† Carolini's,‡ and other observations. In the majority of the animal humours, globules have been found; in the blood, chyle, saliva, the pancreatic juice, the fat, the semen, and the milk, by Leuwenhoeck,§ Hewson,|| and very recently by Home, Prevost, and Dumas, Rafu,¶ Gottfried Reeinhold,** and Ludolf Christian Treviranus,†† &c. have likewise met with them in the proper juices of plants, especially in those of the milky kind. Globules of divers kinds are also seen in the cells of vegetables. Of this sort are those of the starch found in cotyledons; of the albumen of grains of corn and bulbous roots; the resinous globules of chlorophile, in the parenchyma of the leaves, and the coloured globules in the cells of the flowers. Similar globules have also been perceived in the cellular tissue, the serous and mucous membranes, the brain and nerves, the tendons, and the different glands of animals, by Leuwenhoeck, Hook, Swammerdamm, Della Torre, Prochaska, Fontana, &c., and latterly by Barba, Horne, G. R. Treviranus,‡‡ Milne Edwards,§§ Dutrochet,|||| Prevost and Dumas,¶¶ Hodgkins and Lister.* Lastly, they are discovered also in the embryons of plants and animals that are forming, a fact demonstrated by Swammerdamm,† C. F. Wolf,‡ G. R. Treviranus,§ Sprengel,|| L. C. Treviranus,¶ Link,** Rudolphi,†† J. F. Meckel,‡‡ and many others.

* Mem. pour servir à l'Histoire d'un genre de Polypes d'eau douce. Leyden, 1744, p. 54.
† Von den guinen Armpolypen. Ryensburg, 1755, p. 21
‡ Ueber Pfanzenthiere des Mittelmeers, p. 56.
§ Opera omnia seu Arcana Naturæ. Leyden, 1722.
|| Opus Posthumum, Description of the red Particles of the blood. London, 1777.
¶ Entwurf einer Pflanzen Physiologie. Translated from the Danish, by Markussen, p. 91.
** Ueber die Gefasse und den Bildungsaft der Pflanzen, in Vermischten Schriften, v. i, p. 145.
†† Ueber den eigenen Taft der Gewäschse; in Tiedemann's und Treviranus' Zeitschrift fur Physiologie, vol. i, p 147.
‡‡ Ueber die Organischen Elemente des thierischen Körpers; in Vermischten Schriften, anatomischen und Physiologischen Inhalts. Gœttingen, 1816, vol. i, p 117.
§§ Sur la Structure Elementaire des Principaux Tissus Organiques des Animaux, in the Archives Generales de Medicine, 1823, vol. iii. Recherches Microscopiques sur la Scructure in time des tissus Organiques des Animaux; in the Annales des Sciences Naturelles, 1825, vol. ix, p. 362
|||| Recherches Anatomiques et Physiologiques sur la structur intime des Animaux at des Vegetaux, et sur leur Motilité Paris, 1824.
¶¶ Bibliothéque Universelle des Sciences et Arts, vol. xvii.
* Philosophical Magazine and Annals of Philosophy, No. 8, 1827.
† Biblia Naturæ, p 817. He saw globules on the young bull head frogs.
‡ Theoria Generationis, vol ii, pp. 2, 16, 53.
§ Biologie, vol iii, p. 233, vol. iv, p. 9.
|| Von dem Bau und der Natur de Gewäschse. Halle, 1812, p. 71.
¶ Vom inwendigen Bau der Gewäschse, p. 2. Beiträge zur Pflanzen Physiologie, p. 1.
** Grundlehren dei Anatomie und Physiologie der Pflanzen, p. 29, Nachträge, p. 3.
†† Anatomie der Pflanzen, p 27.
‡‡ Vergleichende Anatomie, vol i, p. 40.

XXXV. These globules or corpuscules peculiar to organic bodies, none similar to which are found in minerals, are to be considered as the elementary forms of the former, as the final organic molecules possessing a distinct form which are perceivable in them. Organic matters, in general, appear to have the property of assuming, under certain circumstances, globular forms. This is chiefly remarked when they pass from the liquid to the solid state. G. R. Treviranus saw globules formed during coagulation of the white of an egg, which he had not distinguished in the liquid albumen. Prevost and Dumas observed the same phenomenon in albumen, whose coagulation they had effected by submitting it to the action of the positive pole of the galvanic pile. It is globular corpuscules, also, which first appear when infusoria are formed in the midst of organic matters in a state of decomposition.

XXXVI. These organic elementary globules, whose volume, colour, and other qualities show so many differences in the liquids and solids of plants and animals, form the basis of the different tissues, the presence of which distinguishes living bodies from minerals, wherein nothing that can be compared to them is perceptible. Animal tissues are the consequence of, or are composed by different modes of arrangement of the globules. These are ranged in series and lines in the fibrous tissue of the nerves, of the muscles and tendons. They are extended in the form of lamellæ in the cellular tissue, and those membranes that are chiefly composed of it, as the serous, synovial, and mucous, as well as in the coats of the vessels. They are found variously united in masses in the glandular organs, the liver, the kidneys, the salivary glands, the pancreas and testicles. The tissues of vegetables have not been hitherto sufficiently examined so as to ascertain the precise arrangement of their elementary globules.

XXXVII. The union of tissues, in extremely diversified modes of combination, disposition, and form, gives origin to the parts which we see exercising the different functions in organic bodies, during their life, and which we designate by the name of organs or apparatus for the performance of the different manifestations of life. Parts resembling these are never met with inorganic bodies.

XXXVIII. Organic bodies, at least the more complicated, have their surface supplied with a covering, which confines them, and which surrounds the different liquid and solid parts, organs, tissues, and combinations of tissues, entering into their composition. This covering is called skin in animals and bark in plants. The different sized openings by which it is pierced, permit living bodies to absorb substances from without and to expel substances from within. We find nothing like this in minerals, whose constituent particles are without any means of separation directly exposed to the surrounding media.

XXXIX. All the parts found in, and whose union constitute, organic bodies, are held together by the bonds of a strict causality. In relation to their origin and formation they are dependent on each other. This pro-

position does not only follow from what has already been said concerning the connexion of liquids and solids, but also from the manner in which organized bodies are formed in the midst of matters which produce them. The radicle, proceeding from the fertile seed of a plant, determines the growth of the stalk, which afterwards plays the same part with respect to the leaves and flowers. The parts which appear first are the cause of the manifestations of those that succeed. Thus, in the embryos of the more complicated animals, the two most generally extended apparatus, the nervous and vascular systems, are those which are first formed, and from whose formation that of the others proceeds.

A similar relationship of cause and effect does not exist between the parts whose aggregation produces minerals. When a crystal is formed in the midst of a liquid, the particles of which it is composed are united to each other by the laws of affinity and cohesion alone, without the first which congregate, exercising a determining action on the formation and arrangement of the others, as happens in the formation of organic bodies.

XL. Once produced and formed, the solid and liquid parts remain, so long as they endure, in a continual state of dependence and reciprocity of action,* that is to sav, that they are to each other as cause and effect, or, to employ the expression of Kant,† as means and end. The liquids contained in defined spaces of different kinds, and spread throughout the solids, combine with them, and pass from the liquid to the solid state. The solids, on the other hand, are redissolved and return to the liquid state. Moreover, the liquids act on the organs which they urge to the production of manifestations of activity, while the organs, in their turn reacting on the liquids, keep them in motion and modify their properties. Every part of a plant or animal contributes, by its manifestation of activity, to the preservation of the individual in the full exercise of its faculties, and indirectly also to the maintenance of the species. The duration of vegetables, with a few exceptions, which will be spoken of hereafter, depends on the root, the stalk, and leaves, which all contribute to it by their special functions. These parts and the flowers, or genital organs, which they produce, assure the duration of the species. The same is the case in animals. The organs of digestion, of absorption, of respiration, of the circulation, and of secretion, assure, by the very fact of their manifestations of activity, both their own preservation and that of their numerous apparatus, of the organs of the senses and of the locomotive apparatus, just as the functions of these latter contribute also to the preservation of the other organs and of themselves. The genitals, the existence and the functions of which depend on the other apparatus of the individual, do not re-act on them as cause, nor are they necessary to the preservation of the individual, but they certainly are to that of the species by their manifestations of activity. All the parts, then, which enter into the composition of an organic body, together with their qualities and manifestations of activity, are in a mutual dependence on each other and constitute a perfect whole, so that the particular activity belonging to the individual and to the species is thereby preserved.

The homogeneous particles which constitute a crystal, and which are united by cohesion, have not this reciprocity of action in reference to each other, as Bichat has shown*. They do not act mutually the part of conservative agent and cause, relative to their qualities, as is the case in the parts of an organic body.

XLI. As the different solid and liquid parts, existing in an organic body, are in intimate connexion with each other, and as their duration is conditional on the reciprocity of action of the parts which constitute it, the greater number of living bodies, especially all those that are complex, do not suffer division, without being deprived of their existence and of their own proper activity. Organic bodies, then, in the rigorous acceptation of the word, are individuals which cannot be divided, inasmuch as such division annihilates life in them.

It is true there exist several organic bodies which are susceptible of division to a certain degree, without having their existence compromised by this operation. In this number are many plants, especially perennial plants, and amongst animals, polypi, some radiariæ, and worms. This circumstance does not confute what has been said on indivisibility as a characteristic of living bodies. On one hand, many plants, like polypi, represent an union or collection of several smaller organisms, which may continue to live after they have been detached from their stock. On the other hand, all their parts present a certain uniformity of organization and action, and such an independence, that they are able to exist apart from each other, and produce or regenerate, by their own activity, the parts necessary to the perfection of the species. The character of individuality is the more pronounced, in organic bodies, as their structure is more complicated and their manifestations of activity more varied. On the contrary, a less difference is exhibited by the parts entering into their composition, or the more they are similar, less is the diversity in their actions perceivable, less striking is the character of indivisibility, and more feeble is the connexion of the parts of the same organism, because parts that are similar have the conditions of their existence more in themselves, and are less dependent on each other.

Regarding inorganic bodies, they do not form individuals, because they are the result of an assemblage of homogeneous particles, having no relation of production or preservation with each other, as have the different

* The reciprocal action of the parts in living bodies was known to Hippocrates, since he says (lib. de alimento;) Consensus unus, conspiratio una, conseutiantia omnia ; and in another place (de locis in homine ;) mihi quidem videtur principium corporis nullum esse, sed omnia similiter principium et omnia finis.

† Kritik der Urtheilskraft, v. ii, p. 292.

* Anatomic generale. Introduction, p. 23.

parts of organized bodies. Inorganic bodies can therefore subsist after having been separated into pieces. Each piece of a broken crystal exists as well as if united to the other pieces*. Neither can inorganic bodies reproduce or regenerate, by their own proper power, parts which have been separated from them, as is the case with those simple living bodies that are divisible without loss of existence.

XLII. In reference to the form and composition of bodies, if we examine the changes they undergo during their existence, their duration, their mode of origin, and their relations with external influences, we also here discover considerable differences between those that are organized and those that are not.

The form and aggregation of all living bodies vary during their existence, at stated periods, and according to inherent laws. All vegetables and animals are born with a very simple form, and, at the time of their origin, they are composed, internally, of a very small number of parts, having a simple configuration. By degrees, in proportion as their volume augments, their form and aggregation become more complicated. All of them observe a periodicity in their development. Moreover, we observe, that the majority suffer by degrees, in the progress of age, a sinking in their form, and changes in the composition of their liquids and solids.

(To be continued.)

THE EDITOR'S MOTIVE FOR APPENDING THE MECHANICAL ARTS TO THE JOURNAL OF FOREIGN SCIENCE.

Some of our contemporaries may be surprised to find articles on the Mechanical Arts appended to our Journal of Foreign Science. We beg to call their attention to the reasons which have led us to add this department of interesting matter ; there are at the present moment upwards of 700 accomplished and highly educated medical men scattered over the vast territories of our Eastern possessions. The duties of many consists simply of attending a few sick in a solitary hospital, and the British Government of India have not yet discovered the admirable advantages which would accrue from employing these able men out of the immediate sphere of their profession. Now as there is scarcely a medical man in India who has not acquired some knowledge of chemistry—a knowledge it does not require much penetration and ingenuity to prove might be applied to impr ove the arts and manufactories now going on in the great cities and marts in this country. What soil in the whole world is so rich in productions as this, and so calculated to yield all that is now obtained from foreign countries ? observe to what the genius of chemical science has done for France and England, and what may it not do for India ! !

We are aware that we may be charged with encouraging an indulgence in speculative refinement which has in some instances led men out of the line of useful industry, and by the loss of property, to the ruin of their families. Such has been the result, it is true, but generally speaking, to the artist only, seldom to the man of science. The chemist is better able than one who is only a mechanic to predict from an experiment on a small scale, the probable issue of more extensive attempts. Watt, by a clear insight into the doctrine of latent heat, resulting from his thorough knowledge of chemistry, and seconded by mechanical skill, taught the way to bring the steam engine to perfection. Wedgewood, by the same knowledge advanced the art of manufacturing porcelain, neither must we forget Scheele's discovery of oxygenized muriatic acid and Bethollet's instructions in its application to the art of bleaching, and Sequin and Davy established processes strictly chemical which brought into perfection the art of tanning and preparation of leather. Chemistry is the foundation of those arts that furnish us with saline substances, an order of bodies highly useful in the affairs of

* Richerand has perfectly explained this in the following terms : " Toutes les parties d'un corps vivant, soit vegetal, soit animal, tendent et concourent à un but commun, le conservation de l'individu, et de l'espece ; chacun de leurs organs, quoique doué d'une action particulière, agit pour remplir cet objet ; et de cette sèrie d'actions concurrentes et harmoniques resulte la vie generale, ou la vie proprement dite. Au contraire, chaque partie d'une masse brute ou inorganique est independente des autres parties, aux quelles elle n'est unie que par la force ou l'affinite d'aggregation ; lorsqu'elle en est seperеé elle existe avec toutes ses proprietes caracteristiques et ne differe que par son volume de la masse á la quelle elle a cessé d'appurtenir."

common life. The successful manufactory of glass and various kinds of pottery depends upon a knowledge of the nature of the substances employed, of their fusibility as affected by difference of proportion, or by the admixture of foreign substances, and of the means of regulating and measuring high degrees of heat. The Chemist Berghan taught the most successful manufactory of brick and tiles. The art of malting is most successfully taught by the chemist. Dyeing and printing, as we have already shewn, are a tissue of chemical operation, and in short we should tire our readers by giving further illustration, to shew the utility of this department of our labours to medical men who are generally chemists. If national prosperity in Britain has arisen in an eminent degree from the superiority in the production of her arts, ought they, we enquire, to be neglected in British India? If not, we may boldly put the question—are we not, as having the welfare of India at heart, bound to promote it by a due discharge of our duty by diffusing discoveries on mechanical arts among medical men as the means of communicating them to the natives? We do not pretend to say that chemistry has not been known to the people of India: but we assert that its application to the comforts of the people has hitherto been confined to processes attained by accident, and transmitted from one generation to another without any knowledge of their principles. The division of the people into castes and confinement of trades to certain families, have tended to raise the mechanical arts to their present state of perfection, but then they are stationary,—there is no desire for improvement. Moreover, at present the mechanical arts are confined to the very inferior orders of the people, who being an uneducated class, have no other notions than those which are erroneous and absurd in the highest degree. Their means of conveyance by land and water, and their various kinds of implements and machinery sufficiently prove, all that we have advanced, and shews the necessity which exists that something should be done by the aid of medical men, who are so fitted by their knowledge of chemistry to carry the great work of improvement into execution. It will be a pleasing reflection hereafter to us that if by adding this new department to our labours we shall be promoting the pecuniary interests of the deserving and talented members of our profession, and by diffusing important discoveries in the mechanical arts, be the means of adding to the affluence, the comforts, and the happiness of the natives of India.

We open this department with the present month, by announcing a very important discovery of what is called a Pneumatic Railway. The importance to this country of railway transit will soon be duly estimated, as the native commercial community advance in the knowledge of science and the arts. We shall make no apology for bringing the subject before our readers. We have extracted the article from the Mechanic s Magazine for May, 1835. The editor of that periodical is opposed to the invention, and a discussion is being carried on between the projector and him: but in the present state of the discussion, it would be unprofitable to give the opinions of either to our readers.

THE PNEUMATIC RAILWAY.

A model, of what is called a "Pneumatic Railway," for which Mr. Henry Pinkus has taken out a patent, is now exhibiting in Wigmore-street; and a prospectus is in circulation of a "National Pneumatic Railway Association," to promote the adoption, on "all the railroads in England," of the system of transport of which this model is an exemplification. Copies are also handed about of "Opinions" given by Dr. Lardner and Professor Faraday in favour of the system; and on the strength of these opinions very considerable sums are stated to have been subscribed to the projected "Association." We shall first lay before our readers as much of the prospectus as relates to the scientific merits of the project, and then the "Opinions" of Messrs. Faraday and Lardner entire; after which we shall add something in the way of an opinion of our own.

Extracts from Prospectus of the National Pneumatic Railway Association.

"The improvement consists in the means by which one of the most effective powers in nature is made available to railway transit, and it is applied through the agency of *fixed* steam-engines, arranged at stations *several miles* apart along the line of road; the medium of communication between the stations consti-

tuting the body of the railway itself, which is so formed as to be nearly indestructible.

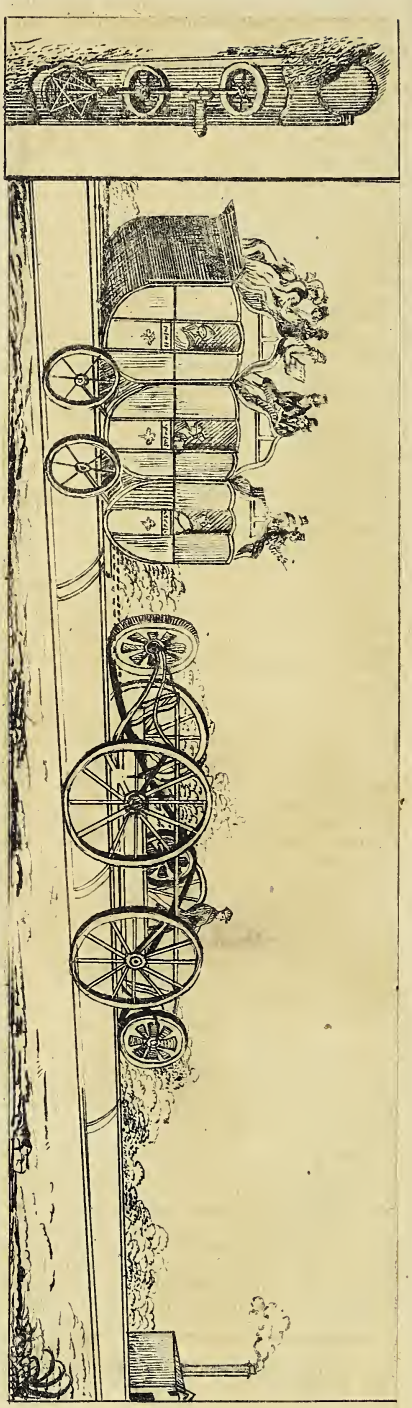
* * * * * * *

"The invention, which is the basis of the improvement now submitted to the public, consists in the means of applying the elastic and forcing power of the atmosphere, obtained by rarefaction, within a hollow cylinder, of from thirty to forty inches in diameter, to carriages and cars *running upon rails on its outer surface*;—the action being produced and transferred by means of pneumatic machinery, worked by sufficiently powerful fixed or local steam-engines.

"Steam-power, used as a first mover, admits of no application so economical as that by means of fixed engines; and thus motive power will be obtained at one quarter the expense of that yielded by the locomotive-engine. The fixed engine gives also the advantage which the locomotive does not possess, that the intensity of its force can be greatly varied to suit the exigencies of the road; and thus it may be rendered available according to the nature of the slope or steepness of the acclivity to overcome the weight to be moved, and the degree of rapidity required. Unlike that of the locomotive-engine, the power of the fixed engine is, *by the improved system*, communicated *with no indirect expenditure to the load or train of carriages;* whilst the power of the locomotive is first applied to bear along its own ponderous bulk—which is of about 10 tons weight, or fully one-fourth of its usual load—and, as before remarked, it destroys both railway and engine by its violent action and concussive force.

"*The power of surmounting acclivities* renders the most direct lines of communication available, and thus shortens the distances between places, and avoids the necessity of circuitous routes in search of levels. Moreover, the improved system of railway permits of roads being laid through a marsh as well as over a common or down, and with no greater expense; thus affording the means, in many cases, of avoiding the annoyance, inconvenience, and expense of running roads through parks, and over arable lands. It may be remarked, too, that the great expense involved in the formation and construction of a railroad upon the common system, is totally sunk in cutting down, or in tunneling through hills, and in building across, or embanking over valleys; whereas the main expense involved in the formation of a road on the improved system, is in common iron castings, which being almost indestructible, and possessing an intrinsic value, little or no loss can accrue upon them.

"Not only does the improved system present a firmer construction of the railway, and a highly economical application of power, but it affords also greater protection to life and property, in the security of the carriages and cars for the conveyance of passengers and goods; since these are so placed upon the rails, and so connected with the railway itself, that they cannot, by any possibility, be thrown off or overturned. In consequence of this advantage, whatever objection may exist in the public mind to travelling upon railways,



because of the danger connected with the common system, will be entirely removed, and a great improvement may be confidently calculated upon in the important item of passenger traffic.

"When it is considered that *by the improved system a line of road may be formed and constructed, for, at the most, two-thirds, and in some cases, for one-half the expense involved by the common system;* and that *such a railway can be maintained and worked with far greater speed, and infinitely greater safety, for three-fourths less than the common system costs;* and that therefore *passengers and goods may be conveyed at one-half the price which the common system demands, and then yield a far greater profit,* competition with the Association will be wholly out of the question.

"As *any degree of speed* can be obtained by the improved system with the most perfect safety, and without the disadvantage, not to say danger, arising from great velocity on the common method, a single line on the new system can be made, by the reciprocating plan proposed, to effect as much transit as can be effected by the use of a double line on the former, while the cost will thereby be lessened nearly one-half. Hence communications that may not warrant the expense of a double line of railway, may be advantageously occupied with a single line; numberless lines are in this manner open to the application of the new system, which the common method will not permit of being attempted.

"As the invention affords the means of applying the power to the common railway, the proprietors of such must soon be found anxious to avail themselves of its advantages; and thus all the railroads in the country may soon become tributary to the Association, while the interests of the various concerns themselves will be materially improved by its adoption."

Prefixed to the prospectus there are two views, of which those on the front page of our present Number are reduced copies; Fig. 1, representing the Pneumatic Railway, as it would appear in actual operation; and Fig. 2, a sectional view of the Railway Cylinder, exhibiting the internal arrangement.

OPINION OF DR. LARDNER.

I have read the specification of the patent for the Pneumatic Railway and the accompanying papers, and have also examined the drawings and models which have been submitted to me by Mr. Hocking.*

Two methods have been heretofore employed for rendering steam power available in transport upon railways; one by causing a travelling or locomotive engine to move with the load which it draws, the other by constructing, at intervals of about a mile and a half, stationary steam-engines, the power of which is transmitted to the load by a rope carried along the road upon rollers or sheaves placed between the rails. The train being attached to this rope is drawn by the power of the engines from station to station. The object of the Pneumatic Railway is to substitute for the rope a partially exhausted tunnel, to employ the fixed steam-engines to work air-pumps by which a rarefaction of the tunnel shall be maintained, and to cause the trains to be tracked upon the railway by connecting them with a diaphragm or piston placed in the interior of the tunnel, so as to have that part of the tunnel in advance of the piston rarefied by the engines, while that part behind the piston is open to the atmosphere. An effective impelling power is thus obtained equivalent to the difference between the pressure of the atmosphere on one side of the diaphragm, and of the rarefied air on the other. ! ! !

Of the *practicability* of this project, I think there can be no doubt. The working of large air-pumps, by an adequate moving power, and the rarefaction of air in tubes or tunnels by such means is not a new idea. It was suggested by *Papin* in the latter end of the seventeenth century, and was even pointed out by him as a means of *transferring power to a distance*, without the loss by friction and other causes consequent upon the use of ropes, or other ordinary means of transmitting force. It is, in fact, a well understood principle in physics, that whatever moving force be expended in producing the rarefaction of air in a cylinder or tunnel, must necessarily be followed by a corresponding force on the other side of a diaphragm moving air-tight in that tunnel, and exposed to the free action of the atmospheric pressure. In the present case, supposing the structure of the valvular cord and the pneumatic piston to be perfect, the opposite side of the diaphragm will always be pressed by an effective impelling force, the amount of which may be calculated upon these principles. It will, of course, be perceived that no original moving power is obtained from the tunnel, or from the rarefied air; the rarefaction gives back the power expended by the stationary engines, and nothing more; and the tunnel must therefore be regarded merely as a substitute for the ropes in the common method of working railways by stationary engines. But it is evidently attended with several advantages in comparison with the latter. A very large proportion of the moving power of stationary engines worked by ropes is intercepted by the resistance from the weight and friction of the ropes, sheaves, barrels, drums, &c. All such waste of power is removed by the pneumatic tunnel.

The original expense of ropes, and their wear and tear, would be likewise saved. Some notion of the extent of this saving may be collected from the following facts:—when the Liverpool and Manchester Railway was about to be brought into operation, a question arose as to the expediency of working it by stationary engines, and estimates of the expense were made by competent engineers. The total amount of capital to be invested in moving power was estimated at about 120,000*l.*; of this above 25,000*l.* was devoted to ropes,

* Professional Director of undertaking the.—Ed. M. M.

sheaves, drums, and other necessary accompaniments. The total annual expense of maintaining the moving power was estimated at 42,000*l*., and of this about 18,000*l*. was appropriated to the wear and tear of ropes, sheaves, &c. &c. Thus it appears that the method of transmitting the power of the stationary engines to the trains by ropes would absorb about 20 per cent. of the invested capital, and their maintenance would consume about 43 per cent. of the annual expenditure.

Another source of comparative economy would obviously be the diminished number of stationary engines. In the estimate already referred to, it was calculated that the distance of 30 miles should be divided into 17 stations, with two 40-horse engines at each station; besides these, there would have been two engines at the bottom of each inclined plane, one at the tunnel, two at the top of the planes, and one at the Manchester end, making in all 42 stationary engines to work a line of 30 miles. Now, according to the estimate of the patentee of the Pneumatic Railway, from three to six stations would be sufficient between Manchester and Liverpool, and the whole line would be worked by from six to twelve steam-engines. Putting aside, therefore, the saving of power which would arise from the substitution of suction in the tunnel for ropes, and supposing the amount of stationary power in both cases to be the same, it will be evident that a material saving would arise from the circumstance of that amount of power being derived from so much less a number of engines—the number of enginemen, assistants, &c., besides the interest on capital, being considerably less.

Some notion of the economy of power likely to arise from superseding the use of ropes may be collected from the result of experiments made by Messrs. Stephenson and Locke, on the resistance arising from the friction of ropes. They found that a load of 52 tons, drawn by stationary engines worked by ropes, through mile and half stages, offered a total resistance amounting to 11,56 lbs.; of this 582 lbs. arose from the friction of the load, and 574lbs. from the friction of the ropes. In the case of the Pneumatic Railway, the friction of the rope is replaced by the friction of the air-pumps and of the impelling apparatus; and it will be evident that the latter, compared with the former, must be almost insignificant. Hence the power wasted in its transmission from the stationary engines to the load, which in one case amounts to 50 per cent. of the whole moving power of the engine, in the other is of comparatively trifling amount.

Slopes on railways will alway be objectionable, whatever power be used; for even the most gentle ascent will increase the resistance of the load in an enormous proportion. The difficulties, however, which they present are materially less when the line is worked by stationary than by locomotive-engines, and would be still further diminished by superseding the rope; the resistance arising from the rope being always greater on inclined-planes than on the level, owing to its increased thickness and consequent weight. A load which requires a $4\frac{1}{2}$-inch rope for the level requires a $5\frac{1}{2}$-inch rope upon a slope of 1 in 100. The weights of equal lengths of these ropes would be in the proportion of about 2 to 3, the slope requiring one-half more weight of rope than the level. Besides this, the moving power on a slope, in addition to the ordinary friction which it has to overcome on the level, has likewise to draw up the weight of the rope—a resistance which will be increased in proportion to the acclivity of the slope.

The disadvantages produced by slopes when locomotive-engines are used are still more formidable. The same engine which is fitted to work upon the level is altogether inadequate for the slopes; the consequence of which is, either, that the locomotive is strained beyond its power by working up the slopes and rapidly destroyed, or that the engines must be more powerful than is requisite for the common level of the road, and thus power and expense wasted; or finally, that an auxiliary engine must be kept constantly ready at the foot of each slope, with its fire lighted and its steam up, ready to help up the trains as they arrive. Unless the trains be almost incessant (which even on the most frequented railroad they never can be), this last expedient, which is the one adopted on the Manchester line, is attended with great waste of power and expense. Stationary engines worked on the pneumatic principle would effectually remove all these difficulties and objections.

The weight of the trains which could be drawn upon the Pneumatic Railway, and the speed of the motion imparted to them would entirely depend upon the power of the stationary engines. As the friction or other resistance does not increase with the velocity, the same absolute expenditure of power would draw the same load at whatever speed. The high speed attained by locomotive engines has been attended with great expense, but this has not arisen from the increased expenditure of power. It has been caused by the wear of the engines themselves, consequent on their rapid motion on the road, and by the necessity of sustaining a fierce temperature, in the fire-place, in order to be able, within the small compass of these engines, to generate steam with sufficient rapidity to attain the necessary rate of motion. As the magnitude of the stationary engines would not be limited, and as they would not be subject to the injurious effects of motion on the road, steam could be produced in sufficient quantity for the attainment of any required speed, without increasing its cost or in any way impairing the machinery.

One of the obstacles to the attainment of great speed by stationary engines worked by ropes, is the delay produced in transferring the trains from engine to engine, and from station to station. The momentum imparted to them is lost at each change, and these changes occur every mile and a half, so that the train has scarcely attained its requisite speed when its motion must again be checked in order to hand it over to another engine. This difficulty is removed by the pneumatic system; there being no rope to be detached and attached, the

engine passes on by its momentum from station to station; and a contrivance is provided, by means of a valve at the stations, by which it is brought under the operation of the next engine without stopping its motion.

Although the danger of accidents to passengers on the present railways worked by locomotive engines, is considerably less than that of travelling by horse coaches on turnpike roads, yet serious accidents have occasionally occurred. These have generally arisen either from the locomotive engine running off the rails—from one train running against another—from the locomotive engine breaking—or, finally, from persons standing upon the rails being run down. In the pneumatic system there is almost a perfect security from these causes of danger. From the engines being stationary, and the tunnel rising between the wheels of the trains, it is evidently impossible for the carriages to run off the road; and from the manner in which the system is worked, it is impossible that one train can run against another. It happens also that the nature of the rails themselves, forming, as they do, merely ledges upon the sides of the tunnel, prevents the possibility of persons standing between or upon them.

In railways worked by stationary engines, serious accidents have occasionally occured by the ropes breaking while the train has been ascending a slope. In such cases the train has run down by its weight with a frightful rapidity, producing the destruction of the carriages and the loss of life. It is evident that this source of danger is removed by the pneumatic system.

An advantage possessed by this system above the edge railroad deserves to be particularly noticed. In the edge railroad the engines and carriages are kept upon the road by flanges or ledges raised upon the tires of the wheels which press on the interior of the rails. Every thing which causes the carriagss to press on the one side or the other, causes these flanges to rub against the rail. When a curve or bend happens in the road, the carriages are guided by the pressure of one or the other flange on the side of the rail, which, of course, is accompanied by considerable friction. In the pneumatic railway there are no flanges, either on the wheels, or rails; the carriages are guided by wheels or rollers placed in a horizontal position, and acting upon the external sides of the channel which receives the valvular cord. By this means all resistance which arises from what is called rubbing friction is removed, and every surface which moves upon another moves upon it with a rolling motion.

(To be continued.)

ON CALICO-PRINTING.

By Thomas Thomson, M. D., F. R. S. L. & E. &c.
Regius Professor of Chemistry in the University of Glasgow.

(Continued from page 23.)

II.—DISCHARGES OF COLOURS. —Most colours are fixed to the cloth by mordants; or if they be metallic oxides, they retain their affinity only that a particular state of oxdizement.* Thus madder is fixed by alumina, and cochineal by means of oxide of tin. Manganese adheres to the cloth only when in the state of sesquioxide, and is washed away by water the moment it is converted into protoxide. Hence, when the printers wish to discharge a colour from cloth, they employ something that will dissolve the mordant, or which will deoxidize the oxide, or colouring matter, if no mordant be present. The *dischargers* or either acids, or substances having a strong affinity for oxygen; the former being employed to dissolve the mordants, and the latter to deoxidize the oxides. The chief of these are the following:—

1. CITRIC ACID is much used to dissolve alumina, and peroxide of iron, and thus to prevent the formation of colour on particular parts of the cloth, by removal of the mordant, which would otherwise produce them. It is obtained by evaporating lemon juice, and thickening it with gum-senegal for the cylinder, or with gum and pipe-clay for the block. Its action is occasionally assisted by bisulphate of potash, or sulphuric acid.

Sometimes the citric acid is first printed on white cloth, and afterwards the aluminous or iron mordant is applied slightly thickened. It is dried immediately to prevent the swelling of the acid figures. At other times, the mordants are first applied, and the acids printed over them.

In both cases, the goods are afterwards passed through hot water, containing cow dung, and well washed before they are dried. This removes the mordants from all those parts to which the acid has been applied, which of course, remains white after the cloth is died.

2. TARTARIC ACID, thickened with gum, is applied by the block, or cylinder, to cloth previously dyed Turkey-red. It is then passed through an aqueous solution of chloride of lime. The acid disengages chlorine from the chloride, which of course, destroys the colour of those parts to which it had been applied, while all the other parts of the cloth retain their red colour. When oxide of lead is deposited on the cloth, along with the acid, and the cloth after passing through the aqueous solution of the bleaching-powder, is passed through an aqueous solution of bichromate of potash. The parts that would have remained white, are converted into a fine yellow. This beautiful process is not confined to Turkey-red.

3. PROTOCHLORIDE OF IRON is used to discharge the manganese brown, and

* Almost every thing which can be applied to cloth, in a state of solution, and which becomes afterwards insoluble in water, either by precipitation, or spontaneous decomposition, sticks to the cloth when it is washed. Water, therefore, does not remove protoxide of Manganese, and the protochloride of tin alluded to at the conclusion of this section, as a means of removing the sesquioxide or peroxide of Manganese, not only takes away their oxygen, but converts them into a soluble chloride.

substitute a buff. This it does, by depriving the manganese of oxygen, and thus rendering it soluble: (the manganese is made soluble by conversion into chloride of manganese) while the protochloride of iron, being converted into perchloride, deposites peroxide of iron on the cloth, which produces the characteristic *buff* or *orange* colours of that oxide.

SULPHATE OF IRON is used in a variety of ways. It deoxidizes the indigo in the indigo vat, and renders it soluble in lime-water. It produces *gold, buff, &c.* colours, and makes a good chemical black with logwood.

4. PROTOCHLORIDE OF TIN, when applied to cloth dyed brown by the sesquioxide of manganese, immediately deoxidizes it, discharges the colour, and leaves the part white. If it be mixed with Brazil wood, or cochineal, it discharges the manganese, but leaves a pink. When mixed with logwood, it leaver a *purple;* and when with Prussian blue, a *blue.*

To produce a yellow upon manganese brown, chloride of tin is mixed with sulphate of lead. This mixture thickened with roasted starch, is printed on the manganese brown. As soon as it is dry, the manganese being reduced to the state of chloride may be washed off; but the sulphate of lead adheres to the cloth, in consequence of an affinity between them. The cloth being now limed, and passed through a solution of bichromate of potash, those parts which contain the oxide of lead are dyed a beautiful yellow.

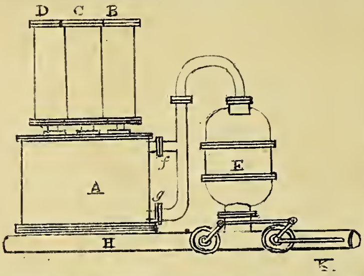
CHLORIDE OF TIN is capable also of removing peroxide of iron from cloth, by reducing it to chloride, as it does the sesquioxide of manganese. For this purpose it is sometimes printed on a deep colour, composed of peroxide of iron and quercition yellow. The protochloride of iron is formed and washed away, while the oxide of tin remaining, constitutes a mordant for the quercitron. Thus the parts to which the tin was applied become yellow.

PROTOCHLORIDE OF TIN is also employed occasionally, to discharge the orange, consisting of dichromate of lead from the cloth. This it does by reducing the chromic acid to protoxide. But as the green oxide of chromium still continues fixed, the discharged parts do not assume a good white colour. But this does not much affect the blue and purple colours substituted for the orange, by mixing the tin with Prussian-blue, or with logwood.

When protochloride of tin is decomposed by carbonate of soda, protoxide of tin is obtained. This protoxide is used along with potash, to render indigo soluble. The protoxide deoxidizes the indigo, and the potash dissolves the yellow base. It is then applied to the cloth in the way that will be explained afterwards.

(To be continued.)

PLAN FOR PROPELLING STEAM VESSELS BY THE RETROACTIVE FORCE OF A COLUMN OF AIR.



Sir,—The above sketch represents a plan for propelling steam-vessels by a powerful current of air ejected from the stern of the vessel. Water has been tried in a variety of ways to effect a similar object, but I am not aware of any trial having been made similar to the plan proposed.

A is the cylinder of the air-pump, with three inverted steam cylinders on the top, marked B C D. The piston rods of the inverted cylinders work the plunger of the air-pump, and are attached to it at equal distances from the centre, and at equal distances from each other. The cylinder of the air-pump being 10 feet diameter, it is presumed that three steam-cylinders so placed would be a better arrangement than with one in the centre, if even equal to the three in capacity.

E, an air-vessel, which the air is forced into at the passages *f g*, alternately, with each stroke of the pump. Those passages have valves to prevent the air returning into the cylinder of the air-pump.

H, a cast-iron pipe running from the prow to the stern of the vessels, and open at both ends to the water. There are two cocks or valves to this pipe, one on each side of the air-vessel. When the air is blowing off to propel the vessel forward; the lever K of the hand-gear is in the situation represented in the figure; when the lever is raised a little higher, the air will rush out at both ends of the pipe H, and neutralize the propelling force, and if raised a little more, it will be discharged at the prow of the vessel only. That a power of starting, stopping, and backing the vessel, may be thus gained, is obvious.

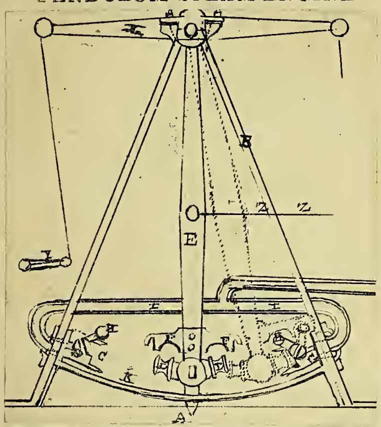
If we suppose the air discharged by the pump to be condensed to one-fourth of its original volume, and the cylinder of the air-pump to be 10 feet diameter, with a 6 feet stroke, making 18 strokes per minute, about 4,000 cubical feet of air would be discharged every minute from the stern of the vessel. *Question.*—What would the probable result of such an experiment be, as respects the velocity of the vessel so propelled, to the power expended, when compared with paddle-wheels? I am, Sir,

Your very obedient servant,

April 24*th*, 1835. J. W.

[*Mech. Mag.* 1835.

PENDULUM STEAM-ENGINE.



Sir,—Encouraged by the readiness which you show to give publicity to all designs and suggestions that have any claim to originality, or are at all likely to be productive of practical good, I take the liberty of sending you a sketch of a new form of a steam-engine, which may be termed a pendulum-engine.

I made a model of an engine on this plan some years ago, and it answered very well; however, I did not then give it publicity, because I had hopes of being able to try its action on a larger scale; but, as an opportunity has not offered itself, I can only speak of it as a model. There are, no doubt, many defects in the plan; and to any of your scientific correspondents, who will do me the favour to point out such defects, and suggest any required improvement, I shall feel much obliged.

DESCRIPTION.

A is the foundation; B B the frame; C C are two short cylinders, opposite to each other, into which swing the pistons at the end of the pendulum rod E, and to which is also affixed two catches, F F for opening and shutting the steam-cocks G G, by means of the levers H H; I I I are the steam-pipes; K is a guide-plate for the pendulum-rod.

The action of the engine is represented by the dotted lines. As the piston vibrates into the cylinder, the short end of the catch passes over the lever, which is carried forward by the long end until the cock is opened; when the action of the steam causing the piston to return, the short end acts upon the lever until the cock is closed: and so on alternately.

The engine might be used for various purposes. Pumps could be connected by means of the cross-beam X, or a rotary motion communicated to machinery by the crank Y and a fly-wheel.

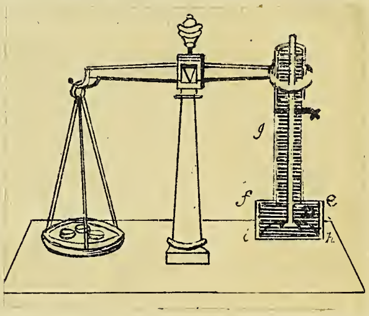
Should the engine be placed at a distance from the pumps, the cross-beam could be dispensed with, and a rod, Z, connected to the pendulum-rod, by which any length of stroke might be acquired by altering the point of connexion.

Should high-pressure steam be an objection, low-pressure could be employed by having two longer cylinders, the pistons being connected by one piston-rod, and the pendulum acting in the middle of it by means of a roller.

I am, Sir, your obedient servant,
CHARLES SLOCKE.

Mechanic's Magazine,
Old-Street, Mill-wall, Pplar, Feb. 12, 1835.

USEFUL RESULT EXTRAORDINARY, OF THE USEFUL KNOWLEDGE SOCIETY'S LABOURS.



SIR,—I perceive from a recent Number of the Mech. Mag., that an ingenious Frenchman is about to take out a patent for that long-sought desideratum, the perpetual motion. Now, sir, as it happens that I have myself lately had the good fortune to achieve the discovery, you will, I hope, admit the propriety of allowing me to enter a caveat in your pages against any foreign rival's pretensions to priority—in case it should turn out, when he enrols his specification, that his method is the same as my own. Thus much, Mr. Editor, is due, even out of bare justice towards the claims of native talent!

My invention (the details of which I will not trouble you with at present) is founded on the principle of the hydrostatic paradox, as that principle is laid down in the first number of the Library of Useful Knowledge, as follows:—

"We have seen how the displacing any portion of a fluid by a solid, whatever by the weight of the solid, produces no difference in the weight of the fluid, provided it stands at the same height as before; and how raising the height of the fluid by plunging a solid into it, increases its weight. If the fluid is raised by pressing or forcing it upwards, in however thin a column, provided the vessel is kept full, and closed in all directions, the pressure of the fluid will be increased, *and the weight of the vessel will be increased*, although nothing whatever, either solid or fluid, is added to it, or made to touch it. The cylindrical box *e f* (see fig.) has a cube *g* fitted into its top, and there is a wire D fitted to a plate D, the size of the inside of the box, and moving up and down in it, water tight. The plate being at the bottom *h i*, water is poured into the box, so that it rises to *e f*, but does not rise in the tube. It is then balanced by a weight in the scale A. If the wire C is drawn up so as to raise the plate, and force

some of the water into the tube, the whole box and water will *weigh* more than it did; and to restore the balance, more weight must be put into the scale A. If the box is three inches diameter, every inch that the water rises in the tube will add above four ounces to the *weight* of the box and tube, whatever be the bore of the tube; for the *pressure* of the water in the box, *in all directions*, will be increased by the weight of a body of water whose height is the height of the water in the tube, and whose base is the extent of the surface of the water passing on the top *e f* of the box. Now the top being three inches diameter, its surface is about $7\frac{1}{2}$ square inches; and a body of water one inch high, and $7\frac{1}{5}$ square inches broad, is $7\frac{1}{5}$ cubic inches of water, which weigh about four ounces. Thus, raising the wire a foot, will *add three pounds to the weight of the water*."—*Library of Useful Knowledge, Hydrostatics*, p. 6.

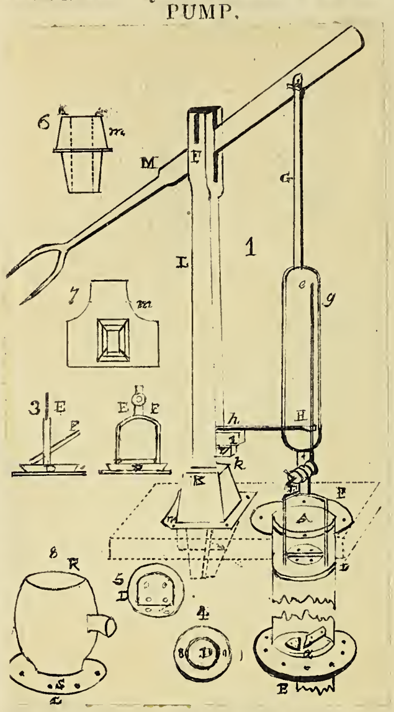
It is by a very simple application of the principle thus set forth, that I propose to effect the desired object; and all I can see to wonder at is, that mankind should have been so long without discovering the grand arcanum, when so convenient a law of nature stared them in the face all the while. There are, indeed, some "roaring infidels," who venture to assert that there is no such law in existence except in the pages of the tract published "under the superintendence of the Society for the Diffusion of *Useful Knowledge*." But can it, for an instant, be believed that so monstrous a blunder as the laying down, with all due pomp and circumstance, of such a non-existent law, could be truly laid to the charge of a learned body, with no less profound a philosopher than my Lord Brougham at the head of it, and whole scores of men of science of first-rate eminence on its committee? The thing is evidently quite out of the question. A friend of mine, indeed, who delights in throwing cold water on all plans of perpetual motion, did startle me a little by observing, that if the pressure of the water in the box were increased equally "in all directions," the upward pressure would exactly counterpoise the downward, and that, therefore, the "*weight* of the box and tube" would remain the same as before! There certainly appears to be something in this objection; but, if it were well-founded, there would be an end at once to my grand project. That being the case, I prefer practice to mere theory, and devoutly believe that, as the committee-men of the the Society would hardly allow their names to be paraded on the covers of the book as having "superintended" its composition, without having actually tested by experiment all the propositions it contains (and especially one so novel and remarkable as that in question,) it is absolutely and literally true that the specific gravity of water, at a given moment, may be *one*, while in the next it may be a hundred, or a hundred thousand!

I remain, Sir,

Your most obedient servant,

April 28, 1835. F. H.

WOOD AND QUANTRILL'S PATENT PUMP.



The writer of the present article is induced to invite attention to the patent pump, which is the subject of it, because he has himself had personal experience of its superiority over other pumps, and believes he will be doing a service, both to the ingenious patentees and to the public, by making its merits more generally known.

The construction of the pump, as will be seen from the prefixed engravings, is remarkable for its simplicity. A perspective, and in part transparent, view of it is given in fig. 1. A is the working chamber; B the suction-pipe; D E F the valve-box, staple, and spear; G *g* the pump-rod; H *h* the stay for pump-rod; I P L the stauncheon; K *k* step to receive the stauncheon; M *m* plate for step of the stauncheon; N pump-handle. Figs. 2, 3, 4, and 5, are detached views of the valve-box, staple, and spear; fig. 2 exhibiting the valve shut, fig. 3 the same open. Fig. 6 is the step, and fig. 7 the plate for the step of the stauncheon. Fig. 8 represents a cistern-head with flanch and nosle.

The point to be particularly noted, in the construction of this pump, is the peculiar position of the suction-pipe B. Instead of being situated under the centre of the barrel, as in other pumps, it is fixed *on one side*; which not only admits of its being much larger in tho bore than usual, but leaves that bore completely open and unobstructed. In the suction-pipes of the pumps in common use the bore is always less at the end attached to the barrel than at the lower end, in conse-

quence of the valve occupying a considerable part of the orifice; and to the extent of the difference, is their efficiency necessarily diminished. The advantages of the simple but important change of position made by Messrs. Wood and Quantrille are, *first*, that a greater quantity of water can be raised by their pump in a given time than by any other known to the writer—one of 6 inches bore, worked by one man, being capable of raising upwards of 76 gallons of water per minute; *second*, that it is not liable to be chocked, all foreign matters that may happen to be sucked up with the water having an open and free passage from the suction-pipe to the working chamber, and thence to the discharge-pipe.

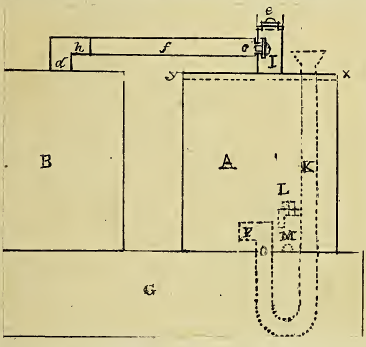
The portability, or other locomobility, of this pump, is another circumstance well deserving attention. It may be shifted or unshifted by one person in a minutes time; and removed by a couple of men from one part of a person's premises, and refixed to another in less than a quarter of an hour. On board of vessels of war, where the decks are often required to be cleared of a sudden, with the utmost possible dispatch, this facility of removal would be found of immense advantage.

Edit. Mech. Mag. C. G. S.

Southampton, May 6, 1835.

[*Mech. Magazine*, 1835.

HYDRO-PNEUMATIC PUMP.



Sir,—I send you a sketch and description of an apparatus for procuring vacuum, which I have lately invented, and which I have called the hydro-pneumatic pump. Should you deem the communication worthy of notice, I should feel obliged by your giving it insertion in one of your early Numbers; and have the honour to remain, Sir,

Your most obedient servant,

W. H. O.

March 17, 1835.

DESCRIPTION.

The apparatus consists of two stout glass cylinders A and B; the one, A, may be termed the condenser; the other, B, the receiver: the former is fixed to the stand G, the latter is moveable, for the purpose of experiment. These cylinders are fitted with two upright brass necks, I *d*; that of A is furnished with a valve *e*, opening *upwards* into the atmosphere, and that of B is bent at a right angle, so as to screw at *h*, on the cross-branch *f*, from the other neck, and thus to form with it an entire air-tight tube, which tube has a valve, *c*, opening *outwards*, by a spring or otherwise, into the neck I. The cylinder A is farther furnished with a tube K, for supplying it with water; it passes through the stand G, enters A at O, and terminates in F. This tube has a cock L, or other similar contrivance, for admitting or intercepting the fluid, as may be requisite; and near to this in A, as shown by the dotted circle M, is another cock for withdrawing the water from A, when necessary, each of these cocks being both air and water-tight.

The pump is put into operation in the following manner—the receiver B having been previously removed for the sake of experiment, by unscrewing its neck *d a b*, and afterwards replaced upon the standing, or rather upon a receiver plate attached to it. First, the cock L being opened, and that at M shut, water is poured or admitted in any other manner into the pipe K, and flows from it into the cylinder A. As it rises it condenses the air within A; the valve *e* is consequently opened, and when it reaches the height indicated by the dotted line *x y*, it has expelled through *e* nearly all the air which the cylinder contained. The valve *e* having again fallen, the cock L is shut so as to cut off the supply or water to A. Now this cock, as well as that at M, being air-tight, and the former having, moreover, above it a column of water, the level of which, by the laws of fluids, corresponds with the line *x y*, it necessarily follows, upon opening the cock at M, so as to allow the water in A to escape, and again shutting it (taking care, of course, not to admit any air from without to pass through it into A), that a vacuum will be left within A; consequently, the air in the receiver B will rush through the cross-tube *f*, and valve *c*, to restore the equilibrium, and will thus become rarefied; this effect will, indeed take place as soon as the air in A assumes a less density than that in B. Further, as the air which A now contains, and which, it is almost superfluous to observe, possesses the same density with that in B, cannot pass back to B, for the valve *c* is now shut, it also follows, that, if the cock L be again opened and water readmitted to A, it will be, as before, condensed, and ultimately driven out at *e*; and, as a consequence, upon a second time opening and shutting the cock at M another vacuum will be created in A; this will, likewise, be occupied by the air from B, which becomes, of course, still more rarefied; and these operations being repeated, the air in B will, at length, be so far exhausted, as to constitute an almost perfect vacuum.

I have not made any reference to the relative size of the cylinders, this being a point of but minor importance. I may, however, observe, it is advisable that A should be more capacious than B (in proportion, for instance, by diameter, of $1\frac{1}{2}$, or $1\frac{1}{4}$ to 1); because, on the withdrawal of the water, the vacuum within A, and consequent rarefaction in B, will be the greater. On the other hand, it is evident

that, if A be made enormously large, it will not only require a considerable quantity of water for its supply, and a long period to fill; but the whole machine will, thereby, be rendered extremely unwieldy and inconvenient. It may, too, perhaps, be as well to state, that, in order to economise the water as much as possible, it may be conducted as it flows from the cock at M, by means of a pipe or otherwise, to a vessel appropriated for its reception, from which it may be again transferred to the cylinder A when required.

W. H. O.

ON THE PRACTICE OF THE BLOW-PIPE.

Dear Sir,—Among the numerous contributions which have at various periods appeared in your pages relative to the construction and management of blow-pipes, I have been surprised at not finding any directions for the practice of the *mouth* blow-pipe; an instrument far exceeding, in utility and convenience, all the artificial combinations which have been invented to supply its place. Thinking, therefore, a communication on the subject likely to prove interesting to your chemical readers, and calculated to promote the employment of this useful little instrument, I am induced to solicit your insertion of the following practical, though somewhat desultory, remarks, and am,

Yours, very truly,

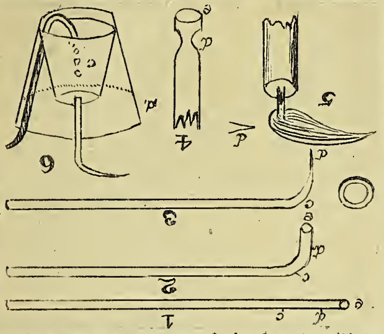
Libertus.

Newington, March 9, 1835.

The introduction of the use of the blow-pipe in practical chemistry may be regarded almost in the same light as the application of the power of steam to the purposes of commerce. If the latter has increased our national resources, and forwarded the interests of mechanical science, by economising the labour and expenditure which were formerly bestowed—the former has in like manner advanced the cause of chemistry and its dependent sciences, by reducing the expense of fuel, time, and material, which were originally required in qualitative analysis. If the mechanic can now produce, with comparative ease and expenditure, an article which, before the introduction of the steam-engine, would have required the labour of many weary days, and the consumption of much valuable material—the modern chemist can, with equal facility, detect the constituent principles of a body which, before the invention of the blow-pipe, would have called in requisition the unremitting exertions of many tedious nights, and the profuse employment of many rare and, perhaps, valuable substances. In fact, by the introduction of this simple, yet invaluable, instrument, the modern chemist can, by his parlour fire-side, and with a common candle, perform those operations, to accomplish which the ancient and less gifted philosopher would have been compelled to resort to the unhealthy atmosphere of a laboratory, and the continued poring over an intensely active fire. The blow-pipe, according to Bergman, had been long employed in the arts by jewellers and others, for the purpose of soldering, before it was applied to the purposes of analytical chemistry and mineralogy, by a Swedish metallurgist of the name of Sual, about the year 1733. This individual appears, however, to have left no written account of the methods which he adopted in its application. The researches of Cronstedt, Bergman, and Gahn,—and, more recently, those of Berzelius and Faraday, have concurred in raising this instrument to the eminent station of utility which it at present enjoys. In the work of Berzelius on this subject, will be found ample instructions for the pursuit of mineralogical and analytical chemistry; and in the "Chemical Manipulations" of Dr. Faraday, the student will meet with copious directions for applying this instrument in the bending and blowing of glass, in practical chemistry. For the former purpose, the mouth blow-pipe possesses undeniable advantages; but for the more fatiguing operations of the latter, the table or hydrostatic blow-pipe will be found convenient. The advantages possessed by the mouth blow-pipe over all those instruments, whose blast is produced by artificial means, consists in its portability, economy, and the facility of immediately suspending or modifying the blast. "The chemist does not possess," says Dr. Faraday, "a more ready, powerful, and generally useful instrument than the mouth blow-pipe, and every student should early accustom himself to its effectual use and application."

The supply of a *continued* stream of air is the chief difficulty which a beginner experiences in learning the use of this instrument; and this difficulty is, I apprehend, not unfrequently increased by the employment of a blow-pipe with too large an orifice, in the first instance. The following method of constructing will, I have reason to believe, be found more efficacious than any other hitherto published, since I have by its means succeeded in less than half an hour in communicating the art of blowing to a class of several persons. Let the pupil procure a tube of glass, *b e* about 13 inches long, and of the size and thickness of *a*. Let him now thoroughly heat the tube at *c*, about two inches from the end, by slowing turning it round in the flame of a candle, or, what is better, a spirit lamp. When he find that it will yield, let him bend it gradually till it has acquired the position represented by fig. 2

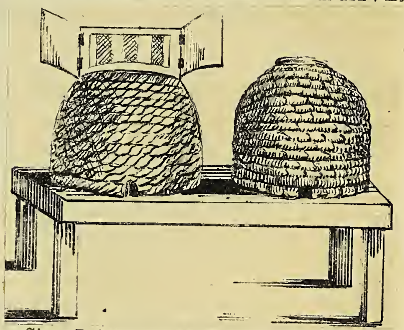
The part *d* is to be heated in the same manner, till it is found soft enough to draw out, when the part *e* must be gradually



withdrawn, as represnted in fig. 4. till it terminates in a point ; this point should be held for a minute or two in the point of the flame, in order to thicken it, and when cold, it is to be ground away with a file, until the smallest possible orifice is visible. The pupil will now be possessed of a blow pipe (fig. 3) with an exceedingly minute jet, and if he puff out his cheeks to the utmost, and place the end *b* within his lips, while the other extremity is held within a short distance of a candle (fig. 5), he will, after a few trials, find no difficulty in keeping the flame *continually*, and *without intermission*, horizontal and clear. The operation which he will be required to perform, in order to keep his cheeks constantly distended, notwithstanding the escape from the jet, cannot easily be described, but will naturally offer itself when the expenditure of air is very small. When the pupil has succeded in keeping up a constant blast for several minutes by this means he may enlarge the aperture by degrees, practising between each enlargement, till he finds he can manage a blow-pipe with a large bore, when he should purchase one of brass, with an ivory or tinned mouthpiece, for general use.

Among the numerous hydrostatic blowpipes which have already appeared in your Magazine, the pupil who wishes to manufacture his own apparatus, may assuredly find one which will form a substitute for the table blow-pipe. I subjoin a plan for one, which may be constructed, at a trifling expense, by almost every student, and in situations where the articles or workmanship requisite for the construction of a more complicated machine could not be procured. A B is a common pail, about half filled with water ; *c* is a large flower-pot inserted, and fastened in by any convenient method ; *d* is a mouth blow-pipe (glass would do on an emergency), fastened in air-tight, with a cork and lute, to the hole at the bottom of the flower-pot ; *e* is a bent tube of glass or metal, terminating under the mouth of the flower-pot. When air is blown in from the mouth at *e*, it rises into the body of the internal vessel and displaces the water, which, in endeavouring to regain its level, forces out the air from the jet of the blow-pipe, with a force proportioned to the height of the column of water displaced.—*Mech. Mag.* 1835.

REV. CHAS. DEWHURST'S BEE-HIVE.



Sir,—I have much pleasure in forwarding you an extract from a lecture delivered, a short time ago, before the members of the Verulam Philosophical Society of London, by its late Secretatry, Charles Dewhurst, Esq.; and if you think likely to interest your readers, I shall feel gratified by its insertion.

The lecture I alluded to was on the Natural History and Management of the Hive or Common Honey Bee (*apis mellifica*), wherein the lecturer detailed a humane and successful plan of securing the honey without depriving the bees of life, which is now generally adopted in the county of Suffolk, and originated with his father, the Rev. Mr. Chas. Dewhurst, of Bury, St. Edmunds. The method employed by this gentleman is as follows:—

" The hive he avails himself of is similar to the one used by the cottagers, with this exception, that it has an opening in its roof of about four inches in diameter ; this has a moveable top (see figure A), which is pegged down whilst the bees are at work and filling the hive. As soon as the latter is full, Mr. Dewhurst (when the bees are absent) carefully, with a knife, separates the top, and places in its stead a wooden box, of about eight inches square, having doors and a glazed front (see figure B), in order that he may view, from time to time, the progress they have made in their work. As soon as the bees have filled this box with honey, it is removed, and another substituted ; and by repeating this process, immense quantities of honey and wax may be obtained, without the least loss or injury to the community. In one year Mr. Dewhurst obtained no less than sixty-three pounds of fine pure honey by this method."

I remain, Sir, your obedient servant,
HENRY W. DEWHURST,
Pre. Ver. Phil. Society of London.

arch 10, 1835.

P. S.—I may add, that Mr. Dewhurs, protects his bees from the weather, robberts &c., in a neat constructed house, about twelve or eighteen inches from the ground.

MISCELLANEOUS LITERARY NOTICES.

BELGIUM.

A Royal Society of Sciences has been established at Antwerp, and, though it has existed only six months, it already boasts of many eminent names of foreign literati among its members, such as Alex. von Humboldt, Charles Dupin, Dr. Pariset, Alexander de la Borde, De Candolle, Magendie, Hufeland, &c. &c.

As connected with literature, it may be interesting to some of our readers to be informed of a remarkable sale of the splendid and valuable collection of the late Count de Rinesse Breidbach, which was to commence at Antwerp on the 1st of October, for the first part, and on the 16th of May, 1836, for the second portion. This second portion contains 50,000 medals and coins, ancient and modern; with a library of 700, works on numismatology; a collection of antiquities, Egyptian, Greek, Roman, Celtic, German, &c,; another of antiquities of the middle ages; a collection of 4000 diplomas, 400 seals, and 10,000 prints,—many of them are extremely rare and curious.

DENMARK.

The museum of nothern Antiquities has received many valuable additions during the last year. The third volume of the Archæonlogical Journal of the society has been printed. The society has also printed a German translation of several of its most interestingarticles, illustrated with numerous plates; but only for theGerman members of the society.

Professor Olshausen of Kiel has announced that the family of the celebrated Carsten Niebhur are now preparing, after a lapse of so many years, to publish the third volume of his Travels in Arabia.

FRANCE.

In the last member of this Journal, we gave a brief account of the great works relative to the national history of France, either projected or already commenced. We have now to advert to a new society, the nature and gigantic plans of which merit a far more extended notice than our limits will here allow us to give, but to which we shall doubtless have occasion frequently to recur. Within the last ten years in new era has commenced in the study and composition of history. Everywhere, and in all the sciences, the historical features are the most prominent; historical schools predomi nate in philosophy and jurisprudence; systems and reasonings give way to pragmatic developments poetry (including romance) draws its materials from history, and the historian admits into his narative more and more of the elements of poetry. The intellectual and moral history of mankind is more and more blended with the political: the history of the sciences and arts, of the ideas, the opinions, the domestic manners of nations everywhere accompanies that of empires, kings and generals. This conviction has given rise in different countries to associations in one and the same historical undertaking, such, for instance, as that under the direction of Uckert and Heeren in Germany, This too has given rise to the society established about sixteen months ago under the title of *Institut Historique*, which has become so extensive, has so many proofs of its activity to produce. and is about to execute such vast plans, that it is high time io call the attention of the learned world to it. The number of the members is about 800, of whom one half are Frenchmen, the others natives of almost all countries. Among the French members are Chateaubriand, Reinard, the Dukes of Broglie, Doudeanville, and Montmorency, Messrs. de Fizensac, Choiseul, Noailles, the Academicians, Micheler, Carnot, Destutt de Tracy, Lamartine, Bory de St. Vincent, G. Saint Hilaire, &c. &c. The historians, such as Thierry, Daru, Capefigue, Barante, of course belong to it. The *Journal de l' Institut historique* began in August last year, and appears regularly in monthly numbers of four sheets. Its chief value, as far as France is concerned, is, that it is the first example in that country of independent criticism. The second undertaking of the society is the *Annuaire de l' Institut historique*, which is composed by a committee of thirty members, and the first annual volume of which will appear in January, 1836, and contain the political and scientific history of Europe for 1835. Another committee is engaged on a *Manual diplomatique*. The commencement of a more intimate personal acquaintance between the European historians is to take place on the 15th of November, for which day the *Institut historique* invites a great European historical congress to Paris, to which all the learned societies in Europe are requested to send deputies. This congress is to sit a fortnight, and questions are prepared in all the classes of the Institute, which are to be submitted to this congress. But the undertaking which is of the greatest importance to Europe, and is unparalleled both in itsplan and the manner of its execution, is the *Dictionnaire de l' Institut historique*, which is intended to supersede all existing historical repertories, and is to be composed under the direction of an association of historians of all nations and countries. The plan is as follows:—The contents of the *Dictionnaire* will be exclusively historical: it will not go beyond the limits of this circle, which is itself so extensive, but it will embrace History completely and in all its phases, and comprehend equally Men, Events, and Things. By Things is understood whatever relates to the history of Science, Language, Art, to the development of human activity in Agriculture, Manufactures Commerce; and it will pay as much regard to the history of the manners and

customs of nations, as to that of political events, which have hitherto been thought alone worthy of detailed notice. The number of the articles will of course be very great; but a simple classification will greatly lessen the labour, and prevent repetitions. The articles are of three kinds. Those of the third class are very short notices, often only larger definitions with reference to the greater articles. Those of the second class relate to Facts, Men, Ideas, remarkable historical Epochs. Those of the first class are devoted to Events and Men that changed the face of a great part of the world (Alexander, Charlemagne), to a great historical period (the Middle Ages), to a great aggregate of countries (Russia, India), to some important social relation (Islamism, Languages, &c.), or lastly to a great class of Nations, or of Mankind in general (the Priesthood, Races). In general the articles relative to *Men (i. e.* individuals) will be much less numerous than those on *Events, Ideas,* and *Things,* otherwise history becomes biography. It is impossible to enter into details respecting the contents of this part of the work: the following are the prominent features:—1. Dynasties; 2. Great Historical Periods; 3. States, Provinces, Cities, and their History; 4. Confederations, Corporations, Religious and Military Orders; 5. Wars, Treaties of Peace, Conventions, Battles, Diplomacy; 6. Governments, Dignities, Offices; 7. Legislation, Laws, Customs, Codes; 8. Finances, Taxation, Loans, Money; 9. Manufactures, Commerce, Navigation, Mines, &c.; 10. Churches, Popes, Councils, Ecclesiastical administration, &c.; 11. Nobility, Third Estate, Peasantry, &c.; 12. Chivalry, Heraldry, Feudalism, Arms, Armies Art of War; 13. Ordinary Life, Liberty, Personal Security, Habitation, Dress, Costumes, Fashions, Furniture, Luxury, Poverty, &c.; 14. Religions, Ceremonies, Festivals; 15. Monuments, Archæology, Cathedrals, &c.: 16. The fine Ars; 17. Literary Activity, Printing, Progress of Philosophy, Theology, Sciences, Discoveries, &c.; 18. Sources and Documents, to facilitate the study of history. The extent of the work is calculated at forty volumes in large 8vo., each of thirty-two sheets, printed in double columns;* four volumes to be published every year. Such is a general, but very imperfect, outline of this great enterprise. A very remarkable circumstance is, that the Institute has resolved to commit the printing of the work to a German House, and commissioned a German member of the society to negociate that business with some eminent German firm. So extraordinary a sacrifice of French national pride seems to indicate that the French book trade must be in a very different state from what it is generally supposed to be.

* It seems to us that these volumes (500 pages each) will be too small. Our Edinburgh Gazetteer of 50 sheets or 800 pages is by no means an inconvenient size.—*Foreign Quarterly for Oct.* 1835..

EXTRA LIMITES.

DWARKANAUTH TAGORE AND THE MEDICAL COLLEGE.

My Dear Bramley,—I am unwilling to offer you my congratulations upon the success which has attended your undertaking in the Medical College, without shewing that my feelings towards the Institution are more substantial than those which words only can express.

Should all your expectations be realized, and there is every reason to believe they will, the Medical College cannot fail to produce the happiest results amongst my countrymen. No man, I assure you, is more sensible than I am of the benefits which such an Institution is calculated to dispense; but I know also that you have many very great difficulties before you, and the greater part of these you will have to contend with at the onset. My own experience enables me to tell you that no inducement to native exertion is so strong as that of pecuniary reward, and I am convinced you will find difficulties disappear in proportion to the encouragement offered to the students in this particular.

As an individual member of the native community, I feel it belongs to us to aid, as far as lies in our power, the promotion of your good cause. At present this can hardly be expected on any very great scale; but as example may be of service to you, I, for one, will not be backward to accept your invitation to my countrymen to support the College.

I beg, therefore, as an inducement to the native pupils now studying in the institution, and to those who may hereafter enter, to offer the annual sum of rupees 2,000 for the ensuing three years, to be distributed in the form of prizes. In order that these may be of substantial value to the candidates, I propose that the prizes should not exceed eight or ten in number, and that they should be available only to foundation students and natives

bonâ fide pupils of the College, all other arrangements in regard to their distribution I leave to your discretion.

Yours very sincerely,
Calcutta, 24*th March*, 1836. (Signed) DWARKANAUTH TAGORE.

We have great pleasure in bringing to the notice of the public the above letter from Dwarkanauth Tagore to Principal Bramley. We have watched with pleasure the liberality and deep interest this native gentleman takes in the enlightenment and prosperity of his countrymen. Whether in the cause of bursting the shackles of the Press, establishing a Fever Hospital, or that of Education, Dwarkanauth Tagore is the foremost, consistent, and devoted advocate. Another of his countrymen* has followed his noble example, and we have no doubt a feeling throughout India will be excited in the native community in support of the great cause of Medical Education. If one circumstance more than another would prove to government that it loses nothing in the end by founding valuable establishments for the benefit of the people, the institution of the Medical College affords that proof. What is the expense after all—a mere drop in the ocean when compared with the vast ulterior benefits to be attained, and we shall be astonished if similar institutions are not forthwith established at Madras, Bombay, and in Central or North Western India. But we again repeat that the Government should liberally pay its professors :—splendid talents, honorable and responsible situations are thus paid in all parts of the world; and the means, extravagant as they appear to one who is ignorant of the principles of political economy, in the end are proved to be the cheapest. Professors Goodeve and O'Shaughnessy at the present moment cannot, without leisure, devote themselves to other pursuits, and consequently their salaries we could venture to prove are insufficient to cover their expences, much less to enable them to purchase those works and instruments so indispensably necessary to their own as well as their pupils edification.

We conceive it to be the duty of an enlightened Government to be the first to lend the helping hand, and in time, no doubt, and the period is not distant, the Medical College and similar institutions will lapse into the hands of the public for support, and the stigma be removed, which is now reflected on British India, that she is without a University.

IMPORTANT DISCUSSION AT THE MEDICAL AND PHYSICAL SOCIETY'S MEETING.

We beg to call the attention of our contemporaries to an important discussion at the meeting of the Medical and Physical Society. The facts elicited from Drs. O'Shaughnessy and Stewart should be brought to the notice of all shipowners and Captains of ships. We had intended to have offered some observations on the subject, but want of space compels us to defer them till our next, when we shall embody what we have to say in our review of Dr. Stewart's paper on Colica Pictonum in the seventh volume of the Transactions of the Society.

MR. JOHN TYTLER.

We understand Mr. Tytler is a candidate for the situation of agent in London to the Upper Orphan School; if he succeeds to the appointment, he will resign the Medical Service in England.

BENGAL MEDICAL RETIRING FUND.

We are happy to learn that our brethren at Bombay are attaining promotion by the operation of their Medical Fund, that being in so flourishing a state it has already furnished

* Baboo Ramgopaul Ghose.

means of retirement to several gentlemen high in the service. The Hon'ble Court has also made it obligatory, we learn, on those now entering the service to join the fund.

It is going on for one year and a half since the medical men here sent the Court of Directors a memorial, to grant similar privileges in proportion to the number of medical men on this establishment, and although there was a rumour that the Court's reply, complying with the prayer of the memorial, had reached India, it has never been published. We have Surgeons therefore on the list upwards of 30 years in the service, and if Government do not do something to ameliorate their condition, how is it possible for them to retire without being worn down by decrepitude and age? The pensions of these gentlemen were they to quit the service, is 190 £ per annum, from which is to be deducted the usual subscriptions for the Military and Orphan Funds. Now we merely put the question whether there is any reward to a professional man for such a length of service—for such sacrifices as he has made, such perils as he has encountered, and whether something ought not to be done to bring into operation the fund to enable him to return once more to his native country, that his bones may be laid in the land of his fathers? The Hon'ble Court of Directors have no doubt long since received three separate memorials on three separate subjects from their medical servants, none of which has yet been replied to. The consequence is, that our brethren are greatly depressed at such disheartening results. There is one act of the committee of management which we think has been most injudicious, that is, their proposition for a discontinuance of the monthly contributions. The larger the amount is, when the sanction of the Court of Directors arrives, the more retirements would be effected, and the fund would have been placed upon a permanent basis; the error may still be rectified, and we should be glad to see a proposition to that effect circulated for the votes of subscribers. We are however glad to say that the Members of the service generally are disposed to afford to the fund their support, which encourages us confidently to predict its complete success eventually. Some few Members have withdrawn in disappointment, but others have enrolled their names—that of Mr. Assistant Surgeon J. Bowron has been recently added, and the fund now embraces 2 Members of the Medical Board, 7 superintending Surgeons, 59 Surgeons, and 108 Assistant Surgeons—total 176.

STATEMENT FROM THE YEAR 1833 TO 1836.

Donations and Subscriptions recovered by Military Pay Department, statement dated 31st August 1833..		Sa. Rs.	5,989	10	1
Do. Do. Do. Statement dated 30th November 1833..		,,	3,106	0	5
Do. Do. Do. by Civil Pay Department, Statement dated 1st November 1833..		,,	3,601	15	4
Do. Do. by Military Pay Department, Statement dated 21st February 1834		,,	5 622	10	7
Do. Do. by Presidency Pay Master, Statement dated 17th March 1834..		,,	1,733	15	10
Do. Do. by Civil Pay Department, Statement dated 17th April 1834..		,,	4,6[illegible]6	2	7
Do. Do. by Military Pay Department, Statement dated 19th May 1834..		,,	10,090	13	3
Do. Do. by Civil Pay Department, Statement dated 22d August 1834....		,,	2,[illegible]96	8	10
Do. Do. by Military Pay Department, Statement dated 22d September 1834		,,	5,830	10	6
Do. Do. Do. Statement dated 7th January 1835..		,,	5,687	6	8
Do. Do. Do. Statement dated 5th March 1835..		,,	1,282	12	13
Do. Do. by Revenue Pay Department, Statement dated 31st March 1835..		,,	414	12	1
Do. Do. Do. Statement dated 31st March 1835..		,,	629	9	2
Do. Do. by Military Pay Department, Statement dated 11th May 1835....		,,	5,461	10	5
Do. Do. by Civil Pay Department, Statement dated 26th June 1835......		,,	1,066	1	1
Do. Do. by Military Pay Department, Statement dated 10th July 1835..		,,	6.660	11	3
Do. Do. by Civil Pay Department, Statement dated 23rd September 1835.		,,	1,378	13	10
Do. Do. Do. Statement dated 13th October 1835..		,,	1,041	7	6
Do Do. by Military Pay Department, Statement dated 2d December 1835		,,	8 270	12	0
Do. Do. Do. Statement dated 11th December 1835		,,	4,657	13	11
Do. Do. Do. by Civil Pay Department, Statement dated 19th March 1836.		,,	1,505	8	11
Do. Do. Do. Statement dated 21st March 1836..		,,	1,501	4	2
		Total Sa. Rs...........	82,707	3	3
Deduct refunded to the widow of Surgeon J. Allan..	784 0 0				
Do. Do. to Do. J. Eckford	784 0 0	,,	1,568	0	0
		Sa Rs...............	81,139	3	3

Deduct received from Presidency Pay Master as follows:—		
Secretary's Salary from 1st January 1833 to 31st January 1835 at Rs. 100 per mensem Sa. Rs.. .. .. .. Sa. Rs.....	2,500 0 0	
Office Establishment from 11th December 1834 to 31st January 1835 at Rs. 50 per mensem..	83 13 7	
Current Expenses..	1,425 9 11	
Contingent do..	93 8 0	4,102 15 6
Nett Sa. Rs............		77,036 3 9
Received from Presidency Pay Master....	4,102 15 6	
Deduct expended..	4,076 12 4	
Balance......	26 3 2	
Expended since the Quarterly Meeting last..	80 11 0	

ORPHAN INSTITUTION.

The General Management of the Military Orphan Fund have informed the Secretary of the Presidency Division, Orphan Committee, that it is their intention to prepare, without delay, a full reply to our pamphlet, and requested that its circulation might be postponed until the reply alluded to could be forwarded to accompany it. Now this is what we have been calling for all along, so that our object will be, it is to be hoped, at last attained, and the subscribers be made fully acquainted with the state of the Institution.

A NEW WAY OF ELECTING A GOVERNOR TO THE FREE SCHOOL.

We are again called upon to notice the proceedings of the Free School, which we shall do as succinctly as possible by merely stating a few matters of fact. At the last monthly meeting of the Governors, notice of Major Taylor's resignation was duly announced; and at the same time was presented a note from one of the absentee Governors, proposing the Revd. John MacQueen as a suitable person to be recommended to the Government as his successor. The Chairman (the Revd. C. Wimberley) with the rest of the Governors then present seemed to be tolerably unanimous in thinking, that the proper course was merely to report the vacancy, and leave the Right Hon'ble the Governor General to exercise his own discretion in filling it up. A day or two after this, the following letter was put in circulation, and received the signatures and minutes precisely as they are here copied.

THE JOINT VISITOR AND GOVERNORS OF THE FREE SCHOOL.

Gentlemen,—Captain Taylor having intimated a wish to resign his office as a Governor of the Free School, and requested that the same might be notified to the proper authorities, may I beg the favour of being instructed in what way to proceed.

I have the honor to be, Gentlemen, your most obedient servant,

April 13, 1836. Anthony Garstin, *Secy. F. S.*

The course hitherto adopted has been to point out some individual, who in the judgment of the Governors would be an active and faithful guardian of the Government interests. I would therefore recommend that the Secretary be authorized to address the Governor General, and to name the Rev. John MacQueen as a proper person to fill the vacancy occasioned by the resignation of Capt. Taylor. *I am most anxious* to have the services of Mr. MacQueen, knowing him to be a most energetic, independent and experienced man. From his connection with the Kidderpore Institution, he is able to render the most essential services to our School, as he fully proved during the period he held the situation of a Governor.

T. Robertson.

I shall be very glad to see Mr. MacQueen a Governor,

R. Molloy,
T. E. M. Turton.
A. M. Sim.
Chas. MacKenzie.

The power of appointment is in the Governor-General in Council. If it has been the course for the Governors of the Institution to recommend persons for appointment, I approve of Mr. MacQueen being recommended; but I think it will be right that we

should see in what instances and under what circumstances such recommendations have been made.

J. J. JUDGE.
H. PARISH.

On the ground that Mr. MacQueen's experience in school business would be an acquisition to the Institution, I concur in the nomination of him by the Rev. Mr. Robertson.

W. BYRNE.

It appears to me to be objectionable in many respect that the Governors recommend to the Governor-General whom he shall appoint to succeed Major Taylor. It is a species of election contrary to that salutary control which should be over every institution, and I conceive contrary to the intention of that rule passed by the subscribers when they allotted to the Governor General the nomination of two Directors. The majority of the Governors of the Free School have carried, however, Mr. Robertson's proposition; in event it can be shewn that it has been customary for the Governors to point out to the Governor-General the individual the Governors desire to see appointed, I trust I may be permitted to call a special meeting of the subscribers to take their opinion whether that course is according to their wishes which has been pointed out by Mr. R.

FREDERICK CORBYN.

Whatever may have been the course hitherto adopted, I beg leave to suggest my opinion, that it would be more correct to leave the Governor General to exercise his own judgment. If his Lordship, on being requested to nominate a successor to Major Taylor, should desire us to point out a suitable person, then and not till then, would be the season for presenting our opinion. I think too, that the regulation (if there be any) prescribing the usage, should have accompanied the circular; and as it has not, I beg the Secretary will re-circulate this along with a copy of such regulation. At the same time I should like to be informed by my more experienced colleagues whether the Government Governors of the Free School have not invariably been servants of the Government. It strikes me, that in other Institutions, placed under the joint management of Government and popular directors, the former are usually, if not invariably covenanted servants. But in this particular I only seek information.

CHARLES WIMBERLEY.

This is a matter of moonshine, we can only intimate Captain Taylor's desire to resign. If Lord Auckland asks our opinion on this most important point, we can give it out, but not till then.

D. MACFARLANE.

In consequence of the two last written minutes, the Secretary so far complied with the instructions of their authors as to re-circulate the proposition with all its accompaniments; and the result proved to be as follows:

THE JOINT VISITOR AND GOVERNOR OF THE FREE SCHOOL.

GENTLEMEN,—I beg to re-circulate the accompanying at the request of Dr. Corbyn and Mr. Wimberley, for the reasons stated in their minutes, viz: the wish on the part of the former to call a special meeting of the subscribers, and of the latter, that any regulation prescribing the usage referred to by Mr. Robertson should be produced for your consideration. There happens, however, to be no such regulation.

I have the honor to be, Gentlemen, your most obedient servant,
ANTHONY GARSTIN, *Sec. F. S.*

It would be a strange regulation indeed to make, that whenever a vacancy in the Government officers occurs, we should recommend a successor. The itch for law making is, I hope, confined to Macaulay's parliament. To the other proposition of Dr. Corbyn, I say no; for I am sadly afraid of speeches which we might peradventure be afflicted with at such a meeting.

T. R.

The objection urged by Dr. Corbyn is very strong, but I would allow this matter in the present instance to take the usual course. I am against a public meeting.

W. BYRNE.

As so many opinions appear to exist on this subject, I would humbly suggest that the simplest, and at the same time the most respectful to the Governor General would be simply to intimate the vacancy and request his Lordship to appoint a successor to Captain Taylor.

A. H. SIM.

I concur with Mr. SIM.

F. CORBYN.
R. MOLLOY.
J. J. JUDGE.
H. PARISH.
C. M.

All I want. C. WIMBERLEY.

It will here be perceived that the matter had taken quite a different turn, and that a majority of the Governors had now come to an amended, though obviously correct

view of the question by determining that the resignation of Major Taylor should be reported to the Government without further note or comment. This we accordingly presumed would be the course adopted, but to our great astonishment we have since learned, that as soon as ever a majority of signatures had been affixed (we hope not before) in favor of the proposition as it stood in the first circular, the Secretary, at the instigation of a single Governor, in breathless haste, despatched a letter in the name of the Governors recommending Mr. MacQueen, without even waiting to ascertain what the residue of the Governors might have to say on the subject. The consequence is, that a letter is now lying before the Government, purporting to be that of a majority of the Governors, whereas the majority, on further consideration, have come to a totally different determination. We forbear to characterize such a proceeding in the terms we think it deserves, and send it forth to abide the issue of its own demerits.

GENERAL ORDERS.

Promotions.—April 4. Asst. Surg. C. Mottley to be Surg. from 10th March, Asst Surg. J. Roneld to be Surg. from 21st March.

Appointments.—March 29, Asst. Surg. R W. Wrightson to 40th N. I. 21st March, Surg. A. N. Magrath, Madras Army, Surgeon to Mysore Residency, April 2, Asst. Apothecary G. Higginson to 4th Batt. Arty., Dum-Dum, 6th April J. Drummond, Esq. Surgeon R. N. to be Surgeon Gov-Genl. from 3d Instant, 6th April, Asst. Surg. A. Stewart, M. D., to do duty Arty Dum-Dum, April 7, Vet. Surg. D. Cullemore to charge horses H. M. 16th Lancers, 17th April. Surg. H. Clarke of 22d N. I. to the Medical charge of the Arty. detail. April 22, Dr. J. S. Login to be Surgeon to the Lieut. Gov.

Removals.—March 26, Asst Surg. H R Bond, to proceed to Benares, 29th Asst. Surg. A. Thomson to the Sirmour Batt. 7th April Asst Surg. A. B. Webster, M. D. to 48th N. I. Apothecary Stewart J. Bensley to Meerut, Apprentice J. Jervis to 16th Foot, at Cawnpore. April 12, Asst. Surg. A. Mackpean, 22d N. I. to that of 3d Local Horse. April 19. R. M. M. Thomson from the 51st N. I. to the European Regt. at Agra.

Leave of Absene.—March 29, Asst. Surg. Spencer for ten days in extension, P. A. April 4 Asst. Surg. R. J. Brassey to Penang P. A. for five months, April 2, Asst. Surg. J. Murray, M. D., 31st March to 1st Nov. to Simla P. A. Asst. Steward T. O. Sullivan from 1st May to 1st Nov. P. A. Surg. T. Campbell, 22d March to 22d July to remain at Mirzapore P. A. April 2. Asst. Surg. W. Godon, M. D. has leave of absence from the 5th to the 22d ultimo, P. A.

Births.—March 28, the Lady of Gar. Surg. A. K. Lindesay, of a daughter.

NOTICE TO CORRESPONDENTS.

The following communications shall appear in our next.

An account of Islampore, by H. Clark, Esq., Surgeon 22d Regt.

On the Canine distemper of Bengal, by J. G.

Surgical Clinique, Cawnpore, operations for Fistula Lachrymalis, by F Brett, Esq.

A case of snake bite, successfully treated by blood letting and cold effusion, by P. Baddely, Esq.

Hunter's Hospital Practice, 2d or Queen's Royal Regt.

Gastro Enteric.
Catarrhal.
Gastro Hepatic.

Dr. Stewart's Clinical, Reports General Hospital.

Case of Intro Suscep, by J. Baker, Esq., Surgeon 10th Light Cavalry.

We beg to acknowledge the receipt of Mr. Ronald's communication on retention of the Placenta.

We also beg to acknowledge the receipt of Mr. Downes's communication of a curious and interesting case from Neemuch.

We have received our talented correspondent Mr. Brett's communication; the subject he has communicated is of infinite importance, and shall be noticed in our next.

Such has been the press of important matter in our present number, that we have exceeded the number of our pages, and have been compelled to omit the article on Medical Topography.

We have received from M. Bermond, the 1st vol. of the Journal des Connaissances Medico Chirurgicales, for which we beg to return our best thanks. There are papers of great value in this volume, which shall be translated, and published in our next.

We have received Mr Baddely's communication; his beautiful drawing of an amastomosis between the 4th nerve and the Casserian ganglion which was lithographed; but a failure occurred in the printing, so that we determined to have it done over again. It will be ready for our next. We beg also to acknowledge the receipt of his second communication with many thanks for his able support.

We beg to acknowledge the receipt of Mr. Anderson's communication from Baboolghur, with its enclosure.

We have just received Mr. Wilson's letter and enclosure.

We beg also to acknowledge the receipt of several letters from our subscribers above Dinapore regarding the delay which occurred in receiving the March number: They will find it was owing to those numbers having been sent by the steamer. The request by several subscribers to send their numbers by Dak will be complied with.

☞ To avoid double postage and the disagreeable necessity of having their copies returned to us, we shall feel obliged if our subscribers will immediately on a change of residence inform us of their new address.

REVIEW
OF WORKS ON SCIENCE
AND
JOURNAL OF FOREIGN SCIENCE AND THE ARTS.
EMBRACING
MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS, &c.

REVIEW.

Journal of the Asiatic Society, 1835. *Analysis of a Tibetan Medical Work.* By M. Alexander Csoma De Körös.

It is a subject of no small curiosity to observe the methods by which natives of different countries adapt the means to the end in the pursuit and attainment of those blessings which providence has placed at their disposal, and it becomes matter of infinitely higher admiration to perceive how the same providence has supplied to all lands the possession of such materials as tend to mitigate the trials and the evils inseparable from the condition of our existence in this world. We find in every quarter of the globe these manifestations of almighty care, exacting our humblest and most unqualified gratitude. The Indian, in his forest, vegetating in a state but little superior to instinct, yet discovers through the medium of his understanding some spontaneous production of the soil, administering to his comfort and his health. A ray of intellectual light pierces the gloom by which he is surrounded, and enables him to ascertain what is essential to the vigor of his frame, the cure of his disease, and the prolongation of existence by the use of such medicaments as the bounty of nature has placed within his reach. His simpler remedies command a prompt and efficacious result, because the general abstemiousness and unartificial course of his career, render the body more subservient to the power of medicine, however rude the treatment or confined the knowledge of his malady. But as society advances, refinement creates a thousand artificial wants, which habit converts to realities, until more intimate acquaintance with the art, *as a Science*, is required to counteract their influences by the application of such skill as will adjust the relief to the peculiar nature of the cause which calls for it. As men become more enlightened they seek refinements which generate diseases foreign to their original condition. To check the properties of these a minuter observation of their sources is obviously demanded; and however lamentable the conviction that luxury has introduced numberless unnecessary afflictions as its consequence, we have still abundant reason to be thankful that the progress of Science at least kept pace with that of society.

We have been drawn into these reflections by the perusal of the leading article in the *Asiatic Journal* for the month of May, 1835. It is entitled, "An Analysis of Tibetan Medicine," and has been supplied by M. Alexander Csoma de Köros, a name already familiar in Oriental literature; and it forms in a certain degree a commentary upon our text, by shewing to what extent research has carried its disciples onward to an intermediate state between the want of all civilization and the acquirement of so much knowledge as belongs to a certain grade of it. It is remarkable that such an insight should have been gained at so early a period, (for the work was written in the 8th century,) and that, having overcome so much, the same talent should have stopped short in its career, even up to this date. In Europe the progress of Science is and has been perpetual since the dark ages; the last step forming but a foundation stone for the erection of the next. Unimpeded by the obstacles of prejudice, or a fondness for ancestral usage, when opposed to the furtherance of larger views, the stream of knowledge flows clearer, freer, broader, daily. Each hour brings to light some novelty, some perception, some improvement which industry and reflection are propelling forward to perfection. The wisdom of to-day eclipses the science of yesterday, and the more the quantity that is

actually gained the greater becomes the thirst, for increase in every branch of intellectual undertaking.

It was perhaps to be expected that a work written at so early a period would not be altogether free from the traces of superstition; and accordingly, we find amongst the avowed predominating causes of illness, that the power of "evil spirits" is allowed to have a very material share. The other portions of the analysis afford abundant proofs of acuteness, with less admixture of absurdity than might have been anticipated. In the history of every nation there is a particular period which exhibits some inherent weakness. Magic and sorcery were long the reputed companions of knowledge, in all the countries of Europe, and formed the secret by which men of loftier minds contrived to establish their dominion over a multitude, rendered apt by its credulity to take upon credit, all that it did not rightly comprehend. It has been questionable whether the disseminators of doctrines, imposing belief in supernatural agency, were in themselves tainted with the *gaucheries* they professed, and it seems but probable that they were not—that they merely made use of them as the means of retaining that ascendancy over human affections, upon which their temporary hopes were based. The priesthood in Spain and in many parts of Italy proclaim such tenets to this day, which being propagat-only for specific purposes, are by no means received as substantial by those who inculcate them.

The mockery of superstition is merely used as a cloak to their more ambitious designs, nor have instances been wanting of acknowledgements, that the pretended efficacy of saints and images was not otherwise valuable, than as it served to blind the weak and perpetuate the subjection of the ignorant. The *pundits* of this country have occasionally admitted that they are pure Deists: and that the fables of their mythology are so many methods, by which they have enthralled a people, ripe in their imbecility for the reception of any folly it became their interest to establish, for the maintenance of that superiority on which their immediate privileges are grounded.

Looking at these facts, it can hardly be a matter of wonder that some indications of this nature should appear in the work before us, on the contrary, we admire that it contains so little of what is objectionable; and are rather disposed to venerate the talent, which in a period of comparative ignorance, could by its unaided efforts have brought into life and activity the advantages of so much usefulness, than to expatiate on the folly of entertaining notions, which after all were not incompatible with the time, or the uncivilized state of society in which it was produced. But we have reachedour limit, and must refer our readers to the substance of the analysis, Perhaps, under a due consideration of circumstances and the allowance we should make for them, it will say more in behalf of the work than any thing that we can profess to utter.

M. de Körös informs us that on application to the Lama, his instructor in the Tibetan language, he obtained from him the work which forms the subject of our present review. It is attributed to Shakya and found its way to Tibet in the 8th or 9th century. A Tibetan interpreter by name Bairotsanah, in the days of Kre Song-Dehütsan translated it into Cashímir, and presented it to the Tibetan King. It was also received by several other learned physicians, and devolved in succession till in the 13th century, when it fell into the hands of Yuthog the II. who "improved and propagated" it. This man is so called in contra-distinction to another of the same name who was celebrated also for his medical attainments at a previous period. In the time of the latter the work became familiar to "nine other learned men." The Lama enumerated several other current works of a similar description, stating that there were 45 in number.

Part 1st. Chap. 1st. Exhibits how Shakya, in the midst of "a forest of medical plants," delivered his lectures, from his palace to a train of auditors.

"He (Shakya) addressed his audience thus:—"Assembled friends! be it known to you, that every human creature who wishes to remain in health; and every man who desires to cure any disease, and to prolong life, must be instructed in the doctrine of medicine. Likewise, he that wishes for moral virtue, wealth or happiness, and desires to be delivered from the miseries of sickness; as also, he that wishes to be honoured or respected by others, must be instructed in the art of healing." Then one of the hermits or Rishis དྲང་སྲོང Drang-Srong) expressing his desire of promoting the-well-being of others, requested his advice as to the manner in which he might become instructed in the doctrine of medicine. Then the teacher (Shakya) said

(or commanded) " He must be instructed in the four parts of the medical science, which are the

རྩ་བའི་རྒྱུད,— : བཤད་པའི་— ;
མན་ངག་གི་— ; and ཕྱི་མའི་རྒྱུད

root or theory, explication, instruction, and lastly, manual operation."

Chap. 2d shews how necessary the medical art is to the preservation of health and morals, and divides the subject into four parts, namely, theory, explication, instruction, and manual operation. From these again are 8 ramifications, 1st, the cure of the whole body ; 2d, particular desires common to children ; 3d, to woman ; 4th, the cure of diseases originating in the influence of evil spirits ; 5th, wounds by knife or spear ; 6th, venomous or poisonous infections ; 7th, the infirmities, senectude ; 8th, the increase of virility in men.

Chap. 3d contains the theory of the human constitution, illustrated by similes. Thus 3 roots of the fig tree or trunks, thence 9 stems, thence 47 boughs, 224 branches, two blossoms and three fruits. The root is the basis of disease, while the stems, branches and leaves exemplify a diseased or healthy condition. The author distinguishes wind, bile, phlegm, with their offices, operations and influences. The supports of the body are seven on which life itself depends, as chyle, blood, flesh, fat, marrow, and semen. The excretions are three, odure, urine, and sweat. The generating causes of diseases are, lust, or ardent desire ; passion or anger ; ignorance or dulness. Of these the first causes wind, the second bile, the last, phlegm. Accessory causes are four. Season with regard to heat and cold ; evil spirits; abuse of food ; and the ill conduct of life. The parts of the body liable to disease are set down as 6 : the skin, flesh, veins, bones, viscera and bowels. There are three humours ; phlegm in the brain or skull, the place of dulness ; bile, in the middle of the body, or place of anger : wind, in the waist, or loins. Wind operates through the bones, ear, skin, heart, arteries and intestines. Bile exhibits itself through the blood, sweat, eyes, liver, bowels. Phlegm, through the chyle, flesh, fat, marrow, semen, odure, urine, nose, tongue, lungs, spleen, kidneys, stomach and bladder. Wind predominates on the diseases of old people ; bile, in youth ; and phlegm, in children : the first abiding in the cold parts of the system, the second in the dry or hot, and the last in the moist or unctuous. Diseases from wind commonly arise during the summer season before noon and about mid-day. Blood during the autumn about mid-day, and mid-night. Phlegm during the spring, morning and evening. Nine maladies are beyond recovery. All are classed under two heads. Wind and phlegm belong to cold, being of " natural water ;" blood and bile, being of natural fire, belong to heat. Worms and serum partake of both.

Chap. 4th on the symptoms of diseases ; examination of the tongue and urine ; of the pulse ; on oral questioning ; on the ascertaining what pain is felt and what food has been used.

" If the tongue is red, dry, and rough, it is the sign of prevailing wind ; if covered with a yellowish white, thick substance, it is the sign of bile ; if covered with a dim, white, soft, and moist substance, it is the sign of phlegm.

" With respect to the urine : if the urine of the patient is blue, clear like spring-water, and has much spume or froth, it is the symptom of wind ; if yellowish, red and thick, steaming or vapouring greatly, and diffusing a smell, it is the sign of bile ; if white, with little smell, and steam or vapour, it is the sign of phlegm.

" With respect to the pulse : When the physician feels the pulse, if beating greatly upwards it somewhat stops, (if irregular) it is the sign of wind ; a quick full beating is the sign of bile ; a sunk, low, and soft beating is the sign of phlegm."

The questions are 29 in number.

Chap. 5th means of curing diseases ; 1st, with respect to food ; 2d, conduct in life and exercise ; 3d, medicaments to be used against the three humours. Those against wind are of three different tastes ; sweat, sour, and saline : and in their efficacy are unctuous, heavy, or soft. Against phlegm, hot, sour, and acrid; their efficacy, sharpness, roughness, lightness. Against bile, sweet, bitter, and nauseous bitter ; efficacy, coolness, thinness, and dulness or bluntness. To this follows the admixture of medicaments with reference to their tastes. These are arranged as assuaging or depuratory. The specified sorts of depuratory medicines, are three ; of purging medicaments, four ; of emeties, two. Respecting physical, or chirurgical operation against wind, there is smearing the body with butter, and the cautery after the Turkish method. Against bile, phlebotomy and cold water, (or bathing in ditto.) Against phlegm warm applications and the cautery.

Chap. 6th re-capitulates the three last, and illustrates the allegory of the fig tree. The

quotation which we now give obviously proves that even in barbarous ages it was discovered that art and science to be clearly treated required arrangement. In the author's Synoptic method, the whole of the subject is seen by the figure of a tree, the branches being the diverging lines from the trunk. The trunk is meant then to represent the system and the branches, leaves, &c. the subordinate divisions agreeably to the laws of similitude and discrepancy.

"According to the former metaphor or allegory of the India fig-tree, there are three roots (or trunks): 1, the root, place, or ground of the disease; 2, that of the symptoms; and 3, that of the manner of curing.

There arise from the first trunk (or root) two stems: that of the unchanged state of the body, and that of the changed or diseased state of the body.

From the 2nd trunk (or root) there arise three stems, namely: those of looking on, feeling, and asking (or of inspection of the tongue and urine; of the feeling of the pulse; and of asking after the circumstances of the disease).

On the 3rd trunk there arise four stems: those of the food; of the manner of living or conduct of life; of the medicaments used; and of the operations performed. Therefore, from the three trunks (or roots) their arise nine stems.

The number of the boughs or branches:

Those branching from the stem of the unchanged body are: disease, the seven supports of the body, and the fæces.

On the stem denoting the changed or diseased state of the body, there are the following 9 boughs: cause of disease, accessory causes, beginning or injured parts, place, way, time of arising (or of the fit), fruit or consequence, causes of transition from one into another disease; the reduction of all diseases to heat and cold.

On the stem denoting the symptoms of diseases, there arise the following eight boughs: 2 of inspecting the tongue and urine. Of feeling the pulse, there are 3: wind-pulse, bile-pulse, and phlegm-pulse. And in asking after the circumstances of the disease, there are 3. Altogether eight.

On the stem denoting the manner of curing, there arise the following boughs or branches: 3 of food or meat; 3 of drink or potion; 3 of the manner of living or of the conduct of life; 6 of physic with respect to taste and efficacy; 6 of the assuaging mixtures, with respect to taste and efficacy; 3 of depuratory physic. There are also 3 boughs of medical (or chirurgical) operations. Thus in all there are 47 boughs or branches.

The number of leaves (or of leafy branches) issuing from the 47 boughs:

1st. On the top of the unchanged stem, the enumeration of 25 diseases.

2nd. On the top the stem denoting the changed or diseased state of the body, 63 symptoms or tokens of indisposition.

3rd. On the top of the stem of inspection (or examination of the tongue and urine), 6 branches or leaves of inspection.

4th. On the top the stem of feeling, three sorts of pulse (or three manners of beating of the pulse).

5th. On the top of the stem of asking the patient about the circumstances of the disease, 29 questions.

6th. On the top of the stem denoting the food (diet, meat, and drink or potion) of the patient, there are the enumeration of such, as: 14 in respect to wind; 12 to bile; and 9 to phlegm.

7th. On the top of the conduct of life, 6.

8th. On the top of the stem of physic nine tastes and nine efficacies are enumerated, together 18; 3 kinds of soup or broth; 5 kinds of medical butter or sirup; 4 kinds of potions; 4 kinds of powders; 2 kinds of pills; 5 kinds powdered aromatics; 9 sorts of depuratory application. Total=50 kinds of physic.

9th. On the top of physical (or chirurgical) operations, 7 leafy branches.

A summary exhibition of the above specified leaves:

1. On the trunk denoting the place and ground of diseases, there are 188 leaves.

2. On that denoting the symptoms, 38.

3. On that denoting the manner of curing, there are 98 leaves. Altogether making 224.

There are two blossoms: health and a long life.

There are three fruits: moral perfection (or good morals), wealth, and happiness.

These are the contents of the six chapters of the first part of this medical tract."

Part 2d. Treats of four things: namely, what is to be cured? or healed? *With* what, in what manner, and by whom? The author's opinions on Conception from the first part of the process by which primordial existence is established, deemed to be involved in too much obscurity to be discovered by the modern physiologist, are both curious and interesting.

"The origin or generation of the body. Cause, and accessory causes thereof. Tokens or signs of birth.

The cause of the generation of the body is stated to be: the father's seed, the mother's blood, and the arising of consciousness. If the first be predominant, there will be born a son; if the second, a daughter; if both are equal, then a hermaphrodite. Should it happen that the blood be formed into two masses then twins will be born.

Out of the semen are formed: the bone, the brain, and the skeleton of the body. Out of the mother's blood are generated the flesh, blood, heart, with the other four vital parts, (lungs, liver, spleen, kidneys,) and the six vessels or veins. From the soul or vital principle arises consciousness through the several organs.

After the body has been thus conceived, the cause of its increase is in the two veins on the right and left sides of the womb, in the small vessel containing the mother's blood for men-

struation, and in the chyle formed from the mother's food, which successively descending into the womb, concurs to the coagulation or union of the semen, blood, and the vital principle, and to their increase, in the same manner, as water is conveyed, by certain canals from a watering pond, to a field, for the production of corn.

The body, by the agitation of the (inward) air, being changed during 38 weeks, goes on continually increasing, for nine months.

The continual increase of the fœtus, or embryo, is thus: In the 1st week, it is like a mixture of milk and blood. In the 2nd week, growing somewhat thick, it is of ropy or tenacious nature. In the 3rd week, it becomes like curds. In the 4th week, from the form, which the embryo takes, is conjectured whether it will be a son, daughter, or hermaphrodite. In the 1st month, the mother suffers both in her body and mind several disagreeable sensations.

In the 2nd month, in the 5th week, the navel of the body is first formed. In the 6th week, vital vein (or artery), depending on the navel. In the 7th week, the forms of both eyes appear. In the 8th week, consequence of the forms of the eyes the form of the head arises. In the 9th week, the shape of the upper and lower parts of the trunk or body is formed.

In the 3rd month, in the 10th week, the forms of the two arms and sides (or hips) appear. In the 11th week, the forms of the holes of the nine organs become perceptible. In the 12th week, the five vital parts (heart, lungs, liver, spleen, veins,) are formed. In the 13th week, those of the six vessels.

In the 4th month, in the 14th week, the marrows in the arms and thighs are formed. In the 15th week, the wrists of the hands and the legs of the feet are perceptible. In the 16th week, the 10 fingers and the 10 toes become visible. In 17th week, the veins or nerves, connecting the outer and inner parts, are formed.

In the 5th month, in the 18th week, the flesh and fat are formed. In the 19th week, the tendons or sinews and the fibres are formed. In the 20th week, the bone and the marrow of the feet are formed. In the 21st week, the body is covered with a skin.

In the 6th month, in the 22nd week, the nine holes of the organs are opened. In the 23rd week, the hair on the head and on the body, and the nails commence to grow. In the 24th week, the viscera and vessels become entirely finished; and then pleasure and pain are felt. In the 25th week, the circulation or motion of air or wind commences. In the 26th week, the memory of the mind begins to be clear.

In the 7th month, the 27th to the 30th week, the whole body comes to entire perfection, or is completely formed.

In the 8th month, from 31st to 35th week, the whole body, both within or without, greatly increases.

In the 9th month, in the 36th week, there arises a disagreeable sensation in the womb. In the 37th week, there arises a nauseous sensation. In the 38th week, the head turning to the entrance of the womb, the birth takes place. But, though the months are completed, yet, on account of the mother's menstruation, and of wind, birth may for some time be delayed.

Farther, it is stated, that if the right side (of the pregnant woman) is high, and the body light, there will be born a son; if the left side is high, and the body heavy, then a daughter; if they both are in an equal state, an hermaphrodite. And if the middle or both the sides are high, then twins will be born.

The tokens and circumstances of approching birth are then described.

We must now bring our review to a close, with a promise to give more extracts in our next.

ON DEFINITE PROPORTIONS.

By D. Spillan, A. M. M. D.

In the chemical combination of bodies with each other, the four following circumstances may be remarked with regard to the *proportions* in which these combinations take place.

1st. Some bodies combine in all proportions, as water and alcohol, water and any of the liquid acids.

2d. In other cases a given quantity of one substance can combine with any quantity of another to a certain extent; thus, four pounds of water can dissolve any quantity of the bicarbonate of soda not exceeding a pound; a hundred grains of water will dissolve any quantity of sea salt not exceeding forty grains, at which point its dissolving power ceases, the cohesion of the solid becoming comparatively too powerful for the force of affinity. In this as well as in the first case, it may be remarked that the substances so combining have but a weak affinity for each other, and that the characteristic properties of each constituent are still discernible in the compound; thus when sugar or sea salt is dissolved in water, the taste of the solution is still similar to that of the substance dissolved.

3d. In some cases substances combine in only one proportion; as chlorine and hydrogen, zinc and oxygen.

4th. In other cases substance are observed to combine in several proportions: thus there are two distinct compounds of copper and oxygen; as also of oxygen and hydrogen. —100 parts of manganese combine with 14, 28, 42 or 56 parts of oxygen. The most interesting and important class of compounds are those comprehended under this and the preceding head, and it may also be remarked that the substances so combining have a strong and energetic affinity for each other, and that the properties which characterised them in the simple state are no longer discoverable in the compound; of this we have an example in sea salt, which formed of two very caustic bodies, has a saline and agreeable taste. These combinations so formed have been observed to obey certain laws, remarkable as well for their generality, as for the simplicity of the relations which they establish between the respective quantities of the principles of the compounds. The

first of these laws is, that all compounds, so long as they retain their characteristic properties, contain the same constant proportion of constituents with the most rigid accuracy, no variation ever taking place; thus nitrate of potash, under all circumstances, and in all situations, consists invariably of 54 parts of nitric acid and 48 of potash. Water consists of one part by weight of hydrogen and eight of oxygen. Carbonate of lime, whether as found in nature, or formed by art, always contains 43.2 carbonic acid and 56.8 lime; and were these elements to unite in any other proportions, some new compound different from carbonate of lime would be formed. The truth of this law is universally admitted. In fact, without such a law to determine and preserve those fixed proportions in the constituents of bodies, there could not be that regularity and uniformity in their composition which we invariably find to exist. The second law is, that, when two bodies combine in different proportions, these proportions are always the product of the multiplication by $1\frac{1}{2}$, 2, 3, 4, &c. of the smallest quantity of one of the bodies, the quantity of the other remaining the same; thus supposing there exist four compounds of oxygen and manganese, and that the least oxygenated of these compounds is formed of 100 parts of manganese and 14 of oxygen; another compound will consist of 100 parts of manganese and 14 + 2 of oxygen; the third compound of 100 parts of manganese, and 14 + 3, &c. There are three compounds of lead and oxygen; the first consists of 104 lead + 8 oxygen: the second of 104 lead + 12 oxygen; the third of 104; lead + 16 oxygen: here the quantity of lead being given, the quantities of oxygen are as the numbers 1, $1\frac{1}{2}$, 2. This law is often called the *law of multiples.* The same may be thus expressed; when any two substances, A and B, unite chemically in two or more proportions, the numbers representing the quantities of B combined with the same quentity of A, are in the ratio of 1, 2, 3, 4, &c.; that is, they are multiples of the smallest quentity of B with which A can unite. With respect to this law we may observe, that when any compound such as A + D, containing several proportions of A combined with a given quantity of B, is decomposed, if the entire of A is not separated, only a defiinite proportion of it is removed at a time; nor are we to suppose that the portion of A, so removed, is derived, from the entire compound A + B, but only from a part of it. This same *law of multiples* has been proved by M. Gay Lussac to hold good also in gaseous combinations, which he has clearly pointed out to take place in simple ratios of volume, and in such a manner as that their condensation also bears a simple ratio to their original volume; this may be illustrated by the following table:

200 vols. hydr. gas	unite with	100 vols. oxygen	and forms water
300	ditto........	100 azote	200 ammoniacal gas.
100	ditto........	100 chlor.	200 hydr. chlor. acid.
100	azote	50 oxyg.	100 protox. azote.
100	ditto........	100 ditto	200 deutox. azote.
100	ditto........	150 ditto	hypo-nitrous acid.
100	ditto........	200 ditto	nitrous acid.
100	ditto........	250 ditto	nitric acid.

Thus if we suppose that two gases unite in different proportions, and that the quantity of the one is constant, the quantities of the other will be such, that the smallest, which may be considered as the first, will be contained a certain integral number of times, whether in volume or weight in the following: The combinations of azote with oxygen, five in number, may serve as an example, by taking the quantity of azote as constant: all contain 100 parts of azote, but the first contains 50 of oxygen; the second 100; the third 150; the fourth 200; the fifth 250; so that the quantity of oxygen in the first is half that in the second; one-third; of that in the third; one-fourth of that in the fourth, &c. whether in volume or in weight. Now as several liquids and solids may be converted into gases, and as this may be done by the application of a sufficiently intense heat, it is quite natural to suppose that these laws of combination are also applicable to bodies of this kind: a fact which several experiments tend to prove: thus, when two bodies, A and B, combine together to form the two bodies C and D, it generally happens that the quantity of A being the same in C and D, that of B in C is to that of B in D as 1 to 2, or to 3, or to 4. It is, however, important to remark, that though there exist relations between the weights of the several proportions of any gaseous body, as oxygen, which may unite with any solid, as manganese, there exists no relation between the weight of the oxygen and that of the metal: thus it cannot be said that 10, 14, 16, &c. grains of oxygen must combine with 100 grains of manganese; the law is restricted to express that 100 grains of metal combining with 14 grains of oxygen, if it be possible to form other combinations between these two bodies, 100 grains of manganese will unite with a quantity of oxygen which will be $1\frac{1}{2}$, 2, 3, 4, 5, or six times as much as the 14 grains. The case is different when instead of establishing a relation between the *weights* of bodies, we establish it between their *volumes*; for then it is observed, not only that there are simple relations between the different volumes of the body A, which combine with a volume of the body B, but also that there exist relations between the respective volumes of A and B. This we may illustrate by an example. 100 cubic inches of azote unite with 50 of oxygen to form a new body; here the oxygen is one half the azote. 100 azote unite with 100 oxygen to form another body; we have a ratio not only between the respective volumes of the azote and oxygen, (a ratio of equality,) but also between the proportions of oxygen in the two compounds, the latter containing twice as much oxygen as the other. Again, 100 azote combine with 150 of oxygen (three times as much as the first) to form a third compound. 100 azote combine with 200 of oxygen to form a fourth, and so on. M. Gay Lussac, to whom we owe the discovery of this law, has also demonstrated that when, in consequence of combination, the volume of the gases is condensed, the condensation bears a simple ratio to the volumes of the gases, or rather to the volume of one of them. Thus

			hydrogen
100 vols. oxyg. with	200 vols.	form 200 vls.	water.
100 vols. azote.....	300 vls.	do. 200	amcal. gas.
100 vols. ditto......	50 vls	oxyg. 100	protox azote
100 vols. ditto	100 vls.	do. 200	deut. azote.

One or two examples may serve to illustrate the application which may be made of these laws of gaseous combination.

1st. If we desire to know the specific gravity of a compound gas, suppose ammoniacal gas, we know by analysis that 200 vols. amniacal gas result from the combination of 300 vols. of hydrogen and 100 vels. of azote. Then, by adding the specific gravity of azote 0,9722 to three times the specific gravity of hydrogen 0,0694 + 3= 0,2082, and dividing the sum 1,1804 by 2,* we have the specific gravity of the compound gas.

Again, we can determine what are the proportions by weight of the elements which constitute a compound gas; it is sufficient for this to take the weight of the vols. of the simple gases, which enter into the composition of the compound gas: for example, the weight of ammoniacal gas will be equal to 0,9722 (sp. gr. of azote) + 0,0694 + 3=0.2082 (3 times the sp. gr. of hydrogen):—if we would reduce these numbers to others more simple, we may institute the following proportion : 9722 : 2082 : : 100 : x. . ∙ . $x = \frac{208200}{9722}$; *i. e.* if 9722 of azote combine with 2082 of hydrogen, 100 azote will combine with 21,41 hydrogen.

If we wish to ascertain the composition of a gas formed of a gaseous element and of a solid body, we shall speedily arrive at it, by taking into account the specific gravity of the compound gas, that of the elementary gas entering into its composition, and the condensation which the latter gas has experienced in combining with the solid body. For example, if we wish to know the quantity of hydrogen and of sulphur entering into the composition of 100 grains of hydrosulphuric acid gas, we can ascertain it thus; we know beforehand, that the volume of hydrogen gas contained in the 100 grains of hydro-sulphuric acid gas is equal to that of this gas; we know also the specific weights of hydrogen gas and of hydrosulphuric acid gas; we then establish the following proportion, if we desire to find the quantity of hydrogen which it contains:

1,1805 : 0,0694 : : 100 : x = the quantity of hydrogen in the gas; that is, the specific gravity of the compound gas, 1,805, is to the specific gravity of hydrogen, 0,0694 as the absolute weight of said compound gas, scil. 100 grs. is to the absolute weight of the quantity of hydrogen contained in the 100 grains of the hydro-sulphuric acid gas.† Therefore, by multiplying the means and dividing by the first term, we shall have the weight of the hydrogen contained in the 100 grs. of the hydro-sulphuric acid gas, and consequently the weight of the sulphur.

Having now considered the doctrine of definite proportions, we come to a subject not less important, and one which is intimately connected with that doctrine, viz. the consideration of *Chemical Equivalents.* The nature of Chemical Equivalents will be best illustrated by comparing the relative quantities of different bodies which combine together. Thus, 8 parts weight of oxygen unite with 1 of hydrogen, 6 of carbon, 16 of sulphur, 36 of chlorine, 200 mercury. Such are the quantities of these bodies, which are found to combine with 8 parts of oxygen; and when any of these bodies combine with each other, they are found to combine either in the proportion expressed by these numbers, or in multiples of them. Thus sulphuretted hydrogen consists of hydrogen and 16 of sulphur; 36 of chlorine combine with 1 of hydrogen to form muriatic acid. Protosulphuret of mercury consists of 200 parts of mercury and 16 parts of sulphur; the bisulphuret of 200 parts of mercury and 32 parts of sulphur. Carbonic oxide consists of 6 parts of carbon and 8 parts of oxygen; carbonic acid of 6 parts of carbon and 16 of oxygen. Thus, hydrogen being taken as the standard, the combining proportions or *Chemical Equivalents* of the several substances just mentioned are:

Hydrogen 1, Carbon 6, Oxygen 8, Sulphur 16, Chlorine 36, Mercury 200. This law of equivalents is not confined to elementary substances; compounds also have their combining proportions, or equivalents, which are found by adding together the equivalents of the several elementary substances which enter in their composition; thus, the equivalent of sulphate of potash is ascertained by adding together the equivalents of sulphuric acid 40 (16 sulphur + 8 × 3 = 24 = 40) and that of potass 48 (= potassium 40 + oxygen 8 = 48,) so that its equivalent is 88. The equivalent of muriate of soda is 69, as being composed of muriatic acid, 37 × soda 32. This law of the combining proportions of bodies may be thus expressed: If two bodies combine together in definite proportions, the proportion in which they enter into combination will have a relation to the proportions in which they combine with all other bodies; thus, if 1 part of hydrogen combine with 8 of oxygen, the same quantities of hydrogen and oxygen

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* The process may be rendered clearer thus: specific gravity of the compound would be equal 0.9722×1.0694+3=1.1804 divided by 4=0.2951, did the component gases suffer no contraction; but as they contract to one half, the real specific gravity is double what it otherwise would be, or 0.5902.

* The principle on which this process depends is, that the bulk of any two bodies being given, their absolute weights are as their specific gravities; in the present instance it was stated, that the bulk of volume of the hydrogen contained in 100 grains of hydrosulphuric acid gas was equal to the bulk or volume of the 100 grains of hydrosulphuric acid gas itself; therefore, as the specific gravity of hydrosulphuric acid gas, 1,1805, is to the specific gravity of hydrogen 0,0694, so will 100 grains of hydrosulphuric acid gas be to the absolute weight of a volume of hydrogen equal to the volume of said 100 grains, which is the precise quantity of hydrogen contained in the 100 grains of hydro-sulphuric acid gas.

will each combine with the same quantity of any other substance, as 16 of sulphur. This law was inferred by Richter from a fact first observed by himself; viz. that when two neutral salts decompose each other, the resulting salts are likewise neutral. Thus, sulphate of soda being added to muriate of lime will give perfectly neutral sulphate of lime and muriate of soda. The reason of this will immediately appear, on considering the equivalents of these substances; thus, if we take 72 parts of sulphate of soda and 65 parts of muriate of lime, the following decompositions take place:

Sulphate of Soda, 72 parts.		Muriate of Lime, 65 parts.
Soda. 32		Muriatic Acid. 37
Sulphuric Acid. 40		Lime. 28

Here the 40 parts of sulphuric acid combine with the 28 parts of lime, and the 37 of muriatic acid with the 32 of soda, no part either of the acid or alkali remaining in an uncombined state. The neutrality will not be at all affected by our taking more or less than 72 parts of sulphate of soda; for if we take more, some of the sulphate of soda will remain undecomposed; if less, we shall have some of the muriate of lime remaining. From this observation Richter inferred, that the quantities of two alkaline bases, sufficient to neutralize equal weights of any one acid are proportional to the quantities of the same bases requisite to neutralize the same weights of every other acid. For instance, 6 parts of potass and 4 of soda neutralize 5 of sulphuric acid; and 4.4 of potass are sufficient to saturate 5 of nitric acid. Therefore, to find the quantity of soda sufficient to saturate this weight of nitric acid, we institute the following proportion: as the potass equivalent to the sulphuric acid is to the potass equivalent to the nitric acid, so is the soda equivalent to the first, to the soda equivalent to the second; or in numbers thus: as 6 : 44 : : 4 : 2.93 = the required quantity of soda, In a similar manner, if 80 parts of soda and 72 of lime saturate 100 parts of sulphuric acid, and if 109 parts of soda saturate 103 parts of muriatic acid, we can then determine the quantity of lime sufficient to neutralize the 100 parts of muriatic acid; thus 80 : 72 : : 109 : 98 = the required quantity of lime.

The converse of this inference of Richter's is also true; viz. that the quantity of any two acids requisite to neutralize equal weights of any one base are proportional to the quantities of the same acids requisite to neutralize equal weights of any other base; thus, 126 parts of sulphuric acid and 87 of muriatic acid neutralize 100 parts of the soda, and 138 of sulphuric acid neutralize 100 parts of lime, how much muriatic acid will produce the same effect? This may be determined by the following proportion: as 126 : 87 : : 138 : 95,3 = required quantity of muriatic acid.

The advantage to be derived from an acquaintance with these principles of chemical combination in proportional quantitites, are too manifest from the examples already given to require further comment. By their aid calculations which otherwise would be tedious and difficult, may be made with ease and certainty; and the precise quantities of substances necessary to produce any required effect at once determined, a matter of considerable importance to the success of chemical manifulations in general, as well as to the conducting of pharmaceutical operations with certainty and despatch. A few instances may be adduced from the Pharmacopœia by way of illustration.

If we want to test the strength of distilled vinegar, we have an easy and sure mode of doing it by ascertaining its neutralizing power. We know that the equivalents of acetic acid and of carbonate of lime coincide; therefore it is obvious that the quantity of marble dissolved by 100 grains of vinegar or any other solution of acetic acid will represent the percentage of real acid in such a sample. For example, let 500 grains of such a solution of acetic acid be put into a basin or flask with 100 grains of marble in fragments, and after the first effervescence is over, warmed, and the neutrality ascertained; the solution is then to be poured off and the remaining pieces of marble washed, dried, and weighed; if 60 grains have disappeared, 60 grains of dry acetic acid were present in the 500 grains of the solution employed. Again, suppose we wish to test the strength of any solution of hydrocyanic acid, we proceed as follows: to 100 grains, or any other convenient quantity of the acid, contained in a phial, small quantities of the peroxide of mercury in fine powder are successively added, till it ceases to be dissolved. The weight of the oxide, divided, by 4, gives the quantity of real acid present. The rationale of this test is: the equivalent of the periode of mercury (216) happens to be just eight times that of hydrocyanic acid (27). Now, as the prussiate of mercury consists of two proportionals of acid to one of base, it is manifest that the quantities of acid and of base in the salt are in the ratio of 1 to 4. Again in the preparation of carbonate of magnesia, for example, the ingredients prescribed are sulphate of magnesia and carbonate of potass; and the quantity of sulphate of magnesia directed being 25 parts, we may ascertain *à priori* the necessary proportion of the carbonate of potass, having recourse to their respective equivalents; thus the equivalent of sulphate of magnesia is 123, and that of carbonate of potass is 70. Now, 123 : 70 : : 25 : 14 q. p. the proportion of carbonate of potass required. For other instances of useful application of the doctrine of equivalents to pharmaceutical purposes, see my Translation of the New Dublin Pharmacopœia, where I have pointed out in the notes the advantage of this doctrine in determining *à priori* the requisite proportion of the several ingredients. The method of determining the proportonal numbers will be considered, when we have come to the subject of the Atomic Theory.

TIEDEMAN'S PHYSIOLOGY OF MAN.

ON THE EXTERNAL CONFIGURATION AND INTERNAL AGGREGATION.

(*Continued from page* 53.)

Crystals do not exhibit, in their form and aggregation changes that can be considered as the results of development or of the epochs of age; they suffer no change whose cause is inherent, and dependent on their duration.

XLIII. All organic bodies, plants as well as animals, in their figure and aggregation, possess a certain duration, varying considerably, according to the genera, species, and individuals, but which, notwithstanding, depends chiefly on circumstances inherent in themselves. The duration of the form and aggregation of inorganic bodies, crystals for instance, is not confined to any determinate period; when they are destroyed it is by the effect of extrinsic circumstances.

XLIV. The origin and production of new organic forms of a species is the result of manifestations of activity in forms already existing. These manifestations of activity, which are called generation, are not the effects of chemical affinity and cohesion, but of a peculiar power, appertaining to organic bodies, exhibited, with specific modifications, in the different species of living bodies, propagated or diffused through the product during the act of generation, and directing the form and aggregation of it, in such a manner that none but beings of the same kind are produced and formed.

The production of new crystalline forms, on the contrary, supposes the destruction, the annihilation, the solution in a liquid, of crystals already existing. Such new crystallized forms, developed as they are according to the simple laws of affinity and cohesion, at the expense of former materials dissolved in a liquid, may differ considerably. Indeed, the researches of Mitscherlich* have taught that a body composed of the same principles, in the same proportions, is capable of assuming different forms. The crystalline form, therefore, does not depend on the nature of the atoms, but on their number and mode of aggregation. The same number of atoms, united in a similar manner, produce one and the same crystalline form.

XLV. The form and aggregation of organic bodies can only subsist and enjoy a certain duration on condition of a reciprocity of action with external things, and more especially on that of a continual change which is going on in their material substance. All organic bodies take from everything around them, and attract the constituent principles of the air water, and food, which they introduce into their composition and form. At the same time divers matters are eleminating form, their composition and form. It is only so long as this change and renewal takes place in the materials, that they continue in the form and aggregation peculiar to them.

* Königl. Vetens. Acad. Handling, 1821, p. 4.

On the other hand, the existence and permanency of the form and aggregation of inorganic bodies, crystals for example, suppose their composition to be in absolute repose, and that no change whatever occurs in them. If external things, which have a greater affinity with their materials, should act on them, they combine with them according to the laws of affinity, and thence follows the destruction and annihilation of their form and aggregation. A renewal of matter, therefore, a thing absolutely necessary to the subsistence of organic bodies, exerts a destructive action on inorganic bodies.

XLVI. From the parallel which has been established between the form and aggregation of organic and those of inorganic bodies, essential differences are collected. All organic bodies have a regular form, terminated by undulating lines and surfaces which are not flat. They all proceed from an assemblage of heterogeneous parts, both liquid and solid, having a peculiar mode of arrangement and distribution, and connected so as to produce an harmonious whole; in other words, engaged in a reciprocity of action necessary to the preservation of the individual. The form and aggregation sway each other mutually; the destruction of one leads to that of the other. All organized bodies preserve their form and aggregation by virtue of an internal activity, under the influence of external circumstances, and amid incessant changes in their material substance of their composition. They are developed from each other, produce themselves, are formed and maintained by their own activity, are subject to regular changes, and enjoy a certain durability.

These bodies thus constitute separate beings, whose various parts, with their different qualities, have a configuration and an aggregation of such a nature that unity, harmony, occurrence of actions to a common end, the preservation of the individual and of the species, may, and in fact do, follow as results. They are relatively more perfect than inorganic bodies.* This superiority of relative

* Absolute perfection belongs to every being whatsoever, since each one is what it ought to be according to the laws of nature. But the different groups of beings present differences as to relative perfection. Bonnet (Contemplation de la Nature, vol. ii. cap. 2) has very clearly expressed himself on this subject, in the following manner: "Tous les êtres sont parfaits, considerés en eux-mêmes; tous repondent à une fin. Les determinations, ou les qualités propres a chaque être, sont les moyens relatifs à cette fin. Si ces determinations changeoient, elles ne seroient plus en rapport avec la fin et il n'y aurait plus de sagesse. Mais à une fin plus noble rèpondent les moyens plus relevés. L'être appellé à remplir cette fin est enrichi de facultés qui lui sont assorties. Considerés sous ce point de vue, les êtres nous offrent differens dégrés de perfection relative. La mesure de cette perfection est dans les rapports que chaqu' être soutient avec le tout. L'être dont les rapports au tout sont plus variés, plus multipliés, plus féconds, possede une perfection plus relevée." We appreciate the relative perfection of an organized body by the multiplicity, the diversity, and the development of its parts. Whenever we observe a great diversity in the organic conformation, we also uniformly see a great variety and combination in the manifestation of life.

perfection is exhibited by the greater number of different parts and matters entering into their composition, as also by the more intimate connexion and more exact reciprocity of action existing between all these parts and matters, so that we cannot but recognise a train of coincidences tending to one end or to unity of end.

XLVII. If, lastly, we put the question, on what rests the property which organized bodies have of exhibiting this disposition, the combination and reciprocity of action, in the parts which compose them, we have no other answer to make, except that it ought to be sought for in their material substance itself, in organic matter All organisms proceed, as far as we can judge of them by observation, from organic matters, which are presented to us as susceptible of organization. At one time they are formed at the expense of an organized individual in which putrefaction is established, as is seen in the case of spontaneous generation, wherein the organisms develope vary according to the external influences to which the organic matters are submitted. At other times, organisms, or organic tissues are formed in a determinate manner, and with an equally determinate form, in the midst of liquid organic matters, produced by the manifestations of activity of organisms already existing, as is observed in generation properly so called, and in the acts of development, of formation, and nutrition. Each species of animal and vegetable presents an organization peculiar to itself, and possesses the faculty of preserving itself, notwithstanding the perishable character and the continual renewal of the individuals. Should we seek to discover whence proceeds this quality of animal and vegetable species, we are lost in the regions of obscurity. Neither do we know more touching the origin of the first individuals of any animal or vegetable species, than concerning that of the organic matters on the surface of our planet. Provisionally we shall designate the faculty or power which organic matters have of taking on organic form and aggregation, in certain circumstances, by the name of plastic power, or power of organization, and regard it as a quality peculiar to these matters, so that we shall consider aggregation by means of purely mechanical or chemical attraction as an especial property of inorganic matter.

THE ACTION OF SALINE SOLUTIONS ON FIBRIN.

By Harry Rainy, M. D.,

Lecturer on the Theory of Physic in the University of Glasgow.

To the Editor of the Records of General Science.

Sir,—You will oblige me by giving the following remarks a place in your Records of General Science. They were partly suggested by Professor Müller's valuable paper on the blood, which appeared in one of your late numbers.

I am, Sir, your obedient servant,
Harry Rainy.

Glasgow, 14*th Oct.*, 1835.

Though it has been generally admitted that fibrin agrees in its chemical properties with coagulated albumen, it has been stated explicitly by Tiedeman and Gmelin, and more recently by Müller, that fibrin is distinguished by the property of dissolving readily in a solution of muriate of ammonia. Such authorities would seem to leave no doubt with regard to the fact; yet, on repeating the experiment frequently some months ago, I did not observe any solution; and I have since noticed that Berzelius had been equally unsuccessful. From these discrepancies it was obvious that there must be some peculiarity either in the state of the fibrin itself, or in the manner of conducting the process, that materially influences the result.

My attention has recently been recalled to this subject by accidentally observing that some fibrin prepared from *human* blood, dissolved almost entirely in a solution of *common salt,* into which it had been put for the purpose of preserving it in a moist state. I was led, by this circumstance, to perform the following experiments :—

1. A portion of moist fibrin, recently prepared from *human* blood, and very carefully washed, was put into a *diluted* solution of *common salt,* at the *ordinary* temperature. It gradually swelled, assumed a gelatinous appearance, and in the course of twenty-four hours, dissolved in the liquid, with the exception of a weak portion of a mucous-like substance, which formed a thin stratum at the bottom of the phial, and which did not dissolve by adding fresh solution.

2. The solution of fibrin (1.) was clear, and frothed readily on agitation. When *heated,* it became opaque, and deposited copious white coagula. This took place at 130° Fahrenheit; consequently, rather at a lower temperature than that at which ordinary albumen coagulates. The precipitate did not re-dissolve on cooling, and seemed, in every respect, to agree in its properties with coagulated albumen.

3. It was natural to suspect, from the last experiment, that the fibrin would not dissolve in any solution of salt heated to 130° or upwards. This conjecture was fully confirmed on trial. Fibrin put into solution of salt at any temperature above 130°, did not dissolve, and could not afterwards be dissolved, even at the ordinary temperature.

It is, therefore, evident that exposure to heat produces some change on fibrin, which prevents its dissolving in solution of salt, exactly as heat renders ordinary albumen insoluble in water. This accounts for the failure of my first trials with muriate of ammonia, for I had heated the solution with the view of accelerating the process; and Berzelius appears to have operated in the same manner.

4. The portion of fibrin which dissolves bears a striking analogy to soluble albumen.

This led me to suspect that its coagulation might be owing to some serum still adhering to the fibrin; but the same results were obtained however carefully the fibrin was washed. And, on the other hand, the fibrin, when kept in pure water underwent no perceptible change, and the water did not extract from it any albuminous matter, for it remained perfectly transparent when boiled. The presence of the salt, therefore, is necessary to resolve the fibrin into the albuminous matter.

5. Some of the solution (1) was mixed with an aqueous solution of corrosive sublimate. No precipitate was produced. I at first supposed that this indicated a decided difference between soluble albumen and the substance which the saline solution extracts from fibrin; but, on making the trial, I found that a solution of white of egg, *mixed with common salt*, is not precipitated by corrosive sublimate. This fact I now find had been previously noticed.

6. Some of the same fibrin, prepared from *human* blood, carefully dried at the *ordinary* temperature, and which had been kept in the dry state for several weeks, was acted on by the solution of salt almost exactly as the recent moist fibrin. It swelled, became white, then transparent and gelatinous, and in a few hours dissolved, leaving a minute quantity of whitish matter, which did not cohere like the mucus left by the recent fibrin. The solution yielded copious coagula when *heated*, exactly like the solution of the recent fibrin.

7. The solution of common salt employed in experiments was dilute. A *saturated* solution does not appear to have any effect in dissolving fibrin; but a mixture of equal parts of saturated solution and water acts distinctly; and when the saturated solution is diluted with four or five times its bulk of water, it acts still more rapidly. I have not ascertained what degree of dilution produces the most effective solutions, but a solution diluted with five times its bulk of water, acts more powerfully than a stronger solution.

8. From some trials I am inclined to think that by far the greater part of the fibrin dissolved is coagulated and precipitated by heat. When this is deposited the solution still retains a minute portion of animal matter, apparently similar to that which is extracted from fibrin by boiling it in water.

9. Solutions of *muriate of ammonia, muriate of lime, muriate of barytes nitrate of potash, sulphate of soda, tartrate of potash and soda, and acetate of soda*, have exactly the same effect on the *fibrin of human blood*, that solution of muriate of soda has. They dissolve by far the greater part of the fibrin, leaving a slight residuum which is either of a mucous consistance, or whitish, and without cohesion. The solution coagulates about 130° Fahr., depositing white flocculi. In like manner fibrin, if once heated to 130°, is not affected by any of these solutions. It is very probable that many of the salts which I have not tried produce similar effects. Solutions of hydriodate of potash, and subborate of soda, dissolve the fibrin, but do not coagulate when heated. I believe they prevent the coagulation of ordinary albumen.

10. The above experiments were made, as I have stated, on fibrin of *human blood*. The experiments which I have made on the fibrin of *ox blood*, and *sheep blood*, have given different results. Fibrin from these sources does, indeed, yield some albuminous matter to the saline solutions, but it is in small quantity. The fibrin retains its cohesion, and the liquid only yields a slight muddiness, or, at most, a very few flocculi when boiled. The solutions of muriate of ammonia, common salt, nitre, and sulphate of soda, appear to be the most effective.

11. I have made some experiments on the action of some of these solutions, on muscular fibre, freed as much as possible from cellular membrane, and carefully washed. In no case was the muscular fibre completely dissolved, or even so much changed as to destroy its fibrous appearance, when viewed with the microscope; but, in general, the muscular matter was softened, and the liquid gave more or less albuminous precipitate when boiled. These effects were most distinct with human muscle, less so with the muscle of haddock, very slight with the muscle of ox, and scarcely perceptible with the muscle of sheep.

12. It follows, from these facts, that fibrin differs materially in its properties, according to the source from which it is derived; that in general it yields to saline solutions, at the *ordinary temperature*, a substance resembling soluble albumen; that the proportion of this substance yielded by fibrin varies materially; that it is greatest in the fibrin of human blood; that fibrin cannot dissolve in solutions of muriate of amonia if heated above 130°; and that several kinds of fibrin are very slightly acted on by that solution at any temperature.

ON THE SESQUI SULPHATE OF MANGANESE.

By Thomas Thomson, M. D., F. R. S., &c.,
Regius Professor of Chemistry in the University of Glasgow.

When neutral solutions of sulphate of zinc and chloride of manganese are mixed together, no sensible change takes place. But if the mixture be concentrated it gradually deposits yellowish-white coloured crusts, which constitute a hitherto undescribed salt of manganese.

This salt dissolves readily in water, but I could not succeed in obtaining it in crystals. Its taste is sweetish and astringent, and slightly acid.

6·26 grs. of it, rendered as dry as possible by pressure between the folds of blotting paper, and subsequent exposure to a gentle heat, were dissolved in water and mixed with a great excess of carbonate of ammonia. The mixture was left for twenty-four hours, and during that time was frequently agitated. It was then thrown on a filter, to collect the white precipitate which had fallen. This precipitate became brown by exposure to the air, and by ignition acquired a reddish tint. In

this state it was red oxide of manganese. It weighed 5·78 grs. = 5·38 grs. of protoxide of manganese.

The ammoniacal liquid was passed through the filter being evaporated to dryness, and the residue re-dissolved in water, left a small quantity of matter, which became red by ignition, and was also red oxide of manganese. It weighed 0·07 = 0·065 gr. of protoxide. So that the whole protoxide of manganese contained in 16·26 grs. of the salt amounts to 5·445 gr.

The liquid thus freed from base was treated with nitrate of silver. The chloride of silver obtained weighed after ignition, 0·5 gr. = 0·12 gr. of chlorine.

The excess of silver being removed by the addition of a little common salt, the liquid was precipitated by muriate of barytes. The sulphate of barytes obtained being collected, washed and ignited, weighed 24·06 grs. = 8·5 gr. sulphuric acid.

What is wanting to complete the 16·26 grs. must be water. For no other constituent could be obtained.

Thus, it appears that the salt is composed of Sulphuric acid 8·5, Chlorine 0·12, Protoxide of manganese 5·445, Water 2·195, Total 16.26

The chlorine was doubtless combined with manganese, probably in the state of trischloride. We must, therefore, subtract 0.36 from the protoxide of manganese. The remainder, 5·085 is the quantity of manganese in combination with the sulphuric acid. Now, 5·1 is to 8·5 as 4·5 to 7·5. So that the salt is composed very nearly of $1\frac{1}{2}$ atom sulphuric acid 7·5, 1 atom protoxide of manganese 4·5, 2 atoms water 2·25, Total 14·25.

The water was rather less than two atoms. Probably a little had been driven off in the attempt to dry the salt by heat.

To what the yellow colour is owing, which this salt possesses I do not know. The solution of it in water is colourless, so that none of the manganese can be in the state of red oxide. I could detect no oxide of zinc in the oxide of manganese, and none could be extracted by digesting the newly precipitated oxide in caustic potash.—*Records of Science*, 1835.

ANIMAL HEAT.

Becquerel and Breschet are at present engaged in a series of experiments upon this subject. Their mode of determining the temperature of different parts of animal bodies is by means of a thermo-electric multiplier, with needles and probes formed of two different metals, soldered in certain points only.

The needles are of two kinds, the most simple being composed of two other needles, the one of platinum, or copper, the other of steel, soldered at one of their extremities in the direction of their lengths, each of them being about half a millimetre (0.0196 inch) in diameter, and a decimetre (3·93 inches) in length. One of these needles is introduced into that part of the body whose temperature is to be determined, the soldered part being placed in the same medium. The two free ends are then made to communicate with the wires of the multiplier. The points of junction, platinum and copper, steel and copper, if the platinum and steel needle is employed, or the points of junction of steel and copper, if the steel and copper needle is employed, are placed in melting ice, in order that the temperature may remain constant. The magnetic needle then deviates, in consequence of the difference of temperature which exists between the point examined and zero. Experience shows that the maximum effect is found between 0º & 25º; therefore, before commencing the experiment, the multiplier may be so adjusted that the needle shall stand between 20º and 25º, in order that the most minute deviations may be noted. When the magnetic needle has acquired a fixed equilibrium, the probe is withdrawn from the part examined, and the corresponding soldered part is plunged into a water-bath, of which the temperature is raised until a deviation is produced, considerably, above that which was previously obtained. The water is allowed to cool, and the temperature corresponding to this deviation is marked by an excellent thermometer. By this method of procedure the following temperatures were obtained. A & B distinguish two persons aged 20 years; C, a person aged 55 years:—

FIRST SERIES OF EXPERIMENTS.—TEMPERATURE OF THE AIR 53º.6'.

NAME OF THE PART, TEMPERATURE.

Brachial biceps of A. 97·75 F. Adjacent cellular tissue 94·46, Mouth 98·24, Brachial biceps of B 98·29, Adjacent cellular tissue 95·81, Mouth 98·06, Biceps of B 98·18, Cellular tissue 95·59, Mouth 98·6.

BLACK DOG.—Flexor Muscle of the thigh 101·12, Cellular tissue of the neck 98·6, Abdomen 101·3, Chest 101·12.

ANOTHER DOG.—Muscle of the thigh 100·4, Chest 98·6, Abdomen 100·58.

SECOND SERIES OF EXPERIMENTS.—TEMPERATURE OF THE AIR 53·6. Biceps of B 98.29, Cellular tissue 96·04, Calf of the leg 98·42, Mouth 98·6 Biceps of C 98·42, Cellular tissue 95.59.

THIRD EXPERIMENT.—BLACK DOG ALREADY SUBMITTED TO EXPERIMENT.—Muscle of the thigh 101·48.

THIRD SERIES OF EXPERIMENTS.

NAME OF THE PART, TEMPERATURE.

Mouth of B 98º·33, Mouth of A 98·51, Mouth of B by thermometer 98·6.

SECOND EXPERIMENT.—Biceps of B 98·78, Cellular tissue 95·86.

THIRD EXPERIMENT.—CARP (CYPRINUS CAPIO.)—Different parts 56·3, Water 55·4.

FOURTH SERIES OF EXPERIMENTS.—MADE WITH PROBES WITH TWO BRANCHES, TERMED NEEDLES OF THE SECOND KIND.

Biceps of B.	1·181	inch deep	98·15
Muscles of the calf....	1·572	,,	98·15
Adjacent cellular tissue.	0·393	,,	94·1
Pectoralis major......	1·573	,,	98·15
Adjacent cellular tissue.	0·393	,,	94·1

SECOND EXPERIMENT,—A YOUNG GRIFFIN OF MEDIUM SIZE.

Pectoralis major......1.572 inch deep		100·85
Cellular tissue........0·393	,,	99 5

THIRD EXPERIMENT UPON B.

Biceps at.. ....1·18 inch deep	97·7
Cellular tissue..	94·1

FOURTH EXPERIMENT,—UPON A DOG.—Muscle of the thigh 101·3, Cellular tissue of the thigh 100·31, the Lung 101·3, Abdomen 101·3.

FIFTH SERIES OF EXPERIMENTS, WITH TWO MULTIPLIERS.—A DOG. —Muscle of the thigh 100·85, Chest 101·9 Brain (the two ends of the probe were admitted by trepanning a small portion 100·85.

From these experiments it appears that, 1. In man the temperature of the muscles exceeds that of the cellular tissue by 4° and 2°$\frac{1}{4}$. 2. The mean temperature of the muscles of three young persons, aged 20 years, was found to be 98·186. With the common thermometer, Dr. Davy estimated the heat of the human body at 98°; and Despretz found the mean temperature of nine men, aged 30 years, 98°·85; of four men, aged 68, 98°·83; of four men, aged 18 years, 98·58. While John Hunter found the temperature of the rectum of a healthy man between 97° and 98°.

3. The mean temperature of the muscles of several dogs is 100·94; while Despretz makes it 103°·06. This difference may be attributed to accidental circumstances. It is to be observed, also, that the state of the health has an effect upon the temperature. The temperature of the brain was 100·85: this temperature was suddenly reduced some degrees, and in a few minutes the animal died.

4. The temperature of the common carp was only about $\frac{9}{10}$ of a degree above that of water.

5. The contraction of the muscles augments the temperature, while the compression of an artery diminishes the temperature. Agitation, motion, and in general every thing which determines a flow of blood, tends to elevate the temperature. Whether the nervous system has any share in producing a rise of temperature remains to be determined.*

PYROXYLIC SPIRIT AND ITS COMPOUNDS.

Dumas and Peligot have published an elaborate examination of pyroxylic spirit, (*Ann. de Chem.* lviii. 1.) which will be found interesting to British chemists, as this substance is becoming a very important article in the laboratory. It was discovered by Philip Taylor, in 1812, who termed it pyroligneous ether, from the mode in which it is prepared. The lowest sp. gr. to which, as far as we are aware, it has been brought in this country, is ·812. Dumas, however, states that its density at the temperature of 68° is ·798, and that of its vapour 1·120. Its boiling point, according to the same authority, is 151°$\frac{3}{4}$, at a pressure of 38 inches.

1. *Pyroxylic Spirit, or Hydrate of Carbydrogen.*—For the purpose of analysis, the pyroxylic spirit was rectified with lime newly burned, and lastly distilled with mercury in a retort supplied with a thermometer which indicated the temperature 151°, from the beginning to the end of the process. Its composition was found to be, carbon, 37·7; hydrogen, 12·5; oxygen, 49·8 This agrees very nearly, taking into consideration the sp. gr., with

1 vol carbon ..	=·4166	= 1 atom ..	.75
2 vols. hydrogen	·1388	2 atoms ..	.25
$\frac{1}{2}$ vol oxygen....	·5555	1 atom ..	1·
	1·1111		2·00

Hence, this substance is a hydrate of carbydrogen, CH $\times$ HO. Dumas has, unnecessarily, coined a new name to distinguish this base, viz. *Methylene*, (from $\mu\varepsilon\theta\upsilon$ wine, and $\upsilon\lambda\eta$ wood). What advantage is gained by this innovation it is difficult even to guess at. The disadvantages of designating simple compounds by arbitrary names (since this compound turns out to be one of the simplest organic compounds with which we are acquainted) are sufficiently obvious, and we trust that this name will not be adopted by British chemists.

The existence of this simple compound of hydrogen and carbon in pyroxylic was demonstrated in 1826 by Dr. Thomson. (*Edin. Trans.* xi. 15, *Inorganic Chemistry*, i. 194, ii. 294.) It is difficult to allow ourselves to suspect that Dumas should have been ignorant of this fact, which has been published for nine years, but in consequence of the absence of any allusion to it, it is impossible, in charity, to avoid drawing such a conclusion. Dr. Thomson obtained the compound of 1 atom carbon $\times$ 1 atom hydrogen the basis of pyroxylic spirit, according to Dumas, by mixing 3 parts of muriatic acid, 1 part nitric acid, and 1 of pyroxylic spirit, applying heat, and receiving the gas disengaged over mercury. The product was, a mixture of a new inflammable gas 29 parts, deutoxide of azote 63, azote 8.

The new gas was composed of 1 vol. carbon, 1 vol. hydrogen, and 1$\frac{1}{2}$ chlorine, containing half an atom more chlorine than the chlrohydrate of methylene of Dumas, which was prepared by heating a mixture of 2 parts of common salt, 1 part of pyroxylic spirit, and 3 parts of concentrated sulphuric acid.

2. DIHYDRATE OF CARBYDROGEN.—If 1 part of pyroxylic spirit be distilled with 4 parts of sulphuric acid, a similar appearance is presented as when alcohol and concentrated sulphuric acid are distilled. During the whole process much gas passes over, containing sulphurous and carbonic acids, which may be removed by caustic-potash. A gas then remains, which is absorbed by water, possesses an ethereal odour,

* Ann. de Chim. et de Phys. lix. 113. (It is to be regretted that the authors do not mention the season of the year when these experiments were made; for, as has been remarked to me, by a distinguished comparative anatomist, the relative temperatures of fishes, and the medium in which they are placed, vary according to the season.—EDIT.)

and burns with a flame like that of alcohol. It is a dihydrate of carbydrogen, or the hydrate of methylene of Dumas, and bears the same relation to pyroxylic spirit that either does to alcohol. It required 3 vols. oxygen to burn it. Its density, by experiment, was 1·617, which corresponds nearly with

2 vols. carbon ..	= ·8332 =	2 atoms	1·5
2 vols. hydrogen ..	·1389	2 atoms	·25
1 vol. vapour of water	·6250	1 atom	1·125
	1·5972		2·875

Hence, its composition is exactly the same as alcohol, in so far as regards the proportions of the elements; but it is obvious, from the difference in their properties, that the elements are differently arranged, the dihydrate of carbydrogen being 2 C H + H O.

The dihydrate is a colourless gas, with an ethereal smell, and does not liquify when cooled to—16° ($3^{\circ}\frac{1}{4}$ F.) Water dissolves about 37 times its volume at the temperature of 18° ($64^{\circ}\frac{1}{2}$), and acquires a smell of ether, and a taste of pepper. Alcohol dissolves it in greater quantity. Sulphuric acid dissolves much of it, and abandons it when diluted with water. It is but justice to state that Macaire and Marcet discovered this gas. It is always a subject of regret to see one man undervaluing the labours of another. Dumas and Peligot have, in the present and preceding instance, by omitting to state the experiments of their predecessors, laid themselves open to this charge. We are willing to believe that it is a fault of omission, rather than of commission, proceeding from their ignorance of the experiments referred to.

3. HYDRO-CHLORATE OF CARBYDROGEN, or of methylene, according to Dumas, is prepared by heating a mixture of 2 parts of common salt, 1 part of pyroxylic spirit, and 3 parts of concentrated sulphuric acid. A gas comes over which may be collected over water. It is a neutral body. It is colourless, smells of ether, with a sweet taste; burns with a white flame, having green edges. Water absorbs 2-8 times its volume at the temperature of 61°. It does not liquify at zero. Its density is 1·736. Hence, its composition is,

1 atom carbydrogen	4860....	875
1 atom hydrochloric acid	1·2847 ..	4·625
	1·7707	5·500

Its formula is therefore C H, × Ch H. this gas is decomposed into hydrochloric acid and carbydrogen by a red heat.

4. HYDRIODATE OF CARBYDROGEN, is formed by distilling 1 part of phosphorus, 8 parts of iodine, and 12 or 15 pyroxylic sprit. The iodine is to be dissolved in the pyroxylic spirit, the solution placed in a retort, and the phosphorus added gradually; a lively action ensues. When it has subsided the rest of the phosphorus is added, and the mixture distilled. On either passes over consisting of pyroxylic spirit and hydriodate of carbydrogen. The latter is separated by the addition of water, which immediately precipitates it. This hydriodate is still impure, and requires to be distilled over an excess of chloride of calcium and massicot, in a water-bath. When pure it is colourless; slightly combustible. sp. gr. 2.237 at $71\frac{1}{2}^{\circ}$. Boils at 104° or 122°. The density of its vapour is 4·883 by experiment. Hence, it consists of

1 vol. hydriodic acid	4·4097
1 ,, carbydrogen	·8460
	4·8957

5. SULPHATE OF CARBYDROGEN.—An oily substance produced by distilling 1 part of pyroxylic spirit with 8 or 10 parts of concentrated sulphuric acid. It is separated by decantation from the liquid with which it is mixed. It is then agitated with a little water, to separate sulphuric acid, then with chloride of calcium, to remove the water, and is afterwards rectified with caustic-barytes, to get rid of sulphurous acid. Lastly, it is kept for some time in a vacuum with concentrated sulphuric acid and potash. It possesses a smell of garlic. Sp. gr. 1·324. Boiling point $71^{\circ}\frac{1}{2}$. The density of its vapour is 4·565. It consists of CH × S O^3 × H O. Its atomic weight is, therefore, 7·

6. NITRATE OF CARBYDROGEN, may be obtained by distilling 50 parts of nitrate of potash, 50 of pyroxylic spirit, and 100 sulphuric acid. A thick and colourless ether remains at the bottom, which must be separated from that which swims over it, by decantation and distillation several times, with a mixture of massicot and chloride of calcium. Even yet it is not pure, for a portion of it boils at 140°. When the temperature rises to 150° the remainder is nitrate of carbydrogen. It burns with a yellow flame. Sp. gr. 1·182. When heated in a tube it detonates violently, which renders it difficult to analyze it. It is easy to see the cause of this, because it contains nitric acid, hydrogen, and carbon, like gunpowder. The density of its vapour is 2·640. Its composition is probably Az O^5 + CH.

7. OXALATE OF CARBYDROGEN, is obtained by distilling equal parts of sulphuric acid, oxalic acid, and pyroxylic spirit. A liquid is procured which, in the air, crystallizes in rhomboidal plates. When the distillation has terminated, the retort is cooled, and 1 part of pyroxylic spirit is added, and distillation performed again with the same results. The crystals are laid on filtering paper, purified by fusion in an oil bath, and distilled over massicot, to deprive them of oxalic acid. They fuse at 124°. Oxalate of carbydrogen dissolves in cold water. It dissolves in alchol and pyroxylic spirit. Ammonia changes it into oxamide. It consists of CH + C^2 O^3 + Aq.

8. ACETATE OF CARBYDROGEN, may be readily procured by distilling 2 parts of pyroxylic spirit with 1 part of crystallizable acetic acid, and 1 part of common sulphuric acid. The product is agitated with chloride of calcium which separates an ether containing much acetate of carbydrogen. A little sulphurous acid and pyroxylic spirit remain, which may be removed by agitation with caustic lime, and digestion for 24 hours with chloride of calcium The density of its

vapour is 2·563. It consists of C H + C^4 H^3 O^3 + H O. It boils at 136°½. Its density is ·919.

9. FORMATE OF CARBYDROGEN.—This ether was prepared by distilling a mixture of equal weights of sulphate of carbydrogen and formate of soda. The product is distilled over a new portion of formate of soda, and lastly, in a retort from a water-bath. Its formula is C H + C^2 H O^3 + H O. The density of its vapour is 2·4.

10. BENZOATE OF CARBYDROGEN, is formed by the distillation of 2 parts benzoic acid, 2 sulphuric acid, and 1 part pyroxylic spirit, and precipitating the product by water. By redistilling the residue of the first operation with new portions of pyroxylic spirit, more benzoate of carbydrogen passes over. The product, after precipitation by water, should be agitated with chloride of calcium, decanted and distilled over dry massicot. It is then to be boiled till the temperature remains fixed about 388°. It is oily, colourless. Sp. gr. 1·10. The density of the vapour is 4·717. It consists of C H + C^{15} H^6 O^3 + H O, or 1 atom of each of the ingredients.

11. CHLORO-CARBONATE OF CARBYDROGEN.—When pyroxylic spirit is admitted into a vessel containing chloro-carbonic acid, muriatic acid and chloro-carbonate of carbydrogen are formed. The latter separates in the form of a heavy oil. Its precipitation is secured by the addition of water. It is then decanted, rectified with a great excess of chloride of calcium and massicot. It is a colourless liquid, very volatile, with a penetrating odour. It burns with a green flame. It consists of 1 atom of acid and 1 of base.

12. SULPHO-CARBYDROGIC ACID, can be formed by the action of sulphuric acid and pyroxylic spirit, but more readily by dissolving the double sulphate of carbydrogen in water, precipitating the barytes by sulphuric acid, and crystallizing the liquid in a vacuum. The crystals are white needles. It is strongly acid, and forms salts with all the bases.

SULPHO-CARBYDROGATE OF BARYTES is prepared by adding gradually 1 part of pyroxylic spirit to 2 parts concentrated sulphuric acid; much heat is extricated. The liquid, after the cessation of action, is diluted with water, and supersaturated slightly with barytes.

The liquid is then submitted to the action of carbonic acid, and again filtered. Sulpho-carbydrogate of barytes remains in a pure and neutral state. By careful evaporation it is obtained in the form of beautiful square plates. The salt is colourless, and effloresces in the air. When strongly heated it is decomposed, and sulphato of barytes remains.

The salt of lime is deliquescent. That of potash crystallizes in pearly plates.

13. AMMONIA SULPHATE OF CARBYDROGEN, or sulpho-methylene of Dumas, is formed by passing a current of dry ammonia over sulphate of carbydrogen. A soft crystalline mass is formed. It may be also procured by the action of liquid ammonia upon sulphate of carbydrogen. The liquid which remains after the re-action, when evaporated in vacuo, furnishes beautiful crystals, whose composition is exactly represented by an atom of anhydrous sulphate of carbydrogen, united to an atom of enhydrous sulphate of ammonia.

14. AMMONIA WITH OXALATE OF CARBYDROGEN, or Oxamethylane of Dumas, is produced when a current of dry ammoniacal gas is passed over oxalate of carbydrogen. A white crystalline mass is formed, when dissolved in alcohol; cubic crystals are obtained by evaporation. In order to understand its composition, we have only to admit that pyroxylic spirit is produced during the action, 2 atoms oxalate of carbydrogen, and 1 ammonia being converted into an atom of oxamethylane, and 1 of pyroxylic spirit.

15. URETHYLANE, is the name given to the product of the action of chloro-carbonate of carbydrogen with ammonia; much sal-ammoniac is formed, and a deliquescent substance crystallizing in needles.

In remarking upon these compounds, Dumas observes, that di-hydrate of carbydrogen is isomeric with alcohol; Bycarbonate of carbydrogen with citric or malic acid; Oxalate carbydrogen with succinic acid; Formate of carbydrogen with acetic acid; Acetate of carbydrogen with formic ether; Citrate of carbydrogen with anhydrous sugar.

ANALYSIS OF OPIUM.*

Couerbe gives the following method for analyzing this complicated substance, as proposed by Gregory:

The opium is first taken up by cold water, and then concentrated, chloride of calcium is added to the solution, in the proportion of 2 ounces to the pound of opium It is then boiled and allowed to crystallize. When the whole has become solid, the crystals are submitted to pressure. The crystals contain *Codeine* and *Morphine* united to muriatic acid.

The liquid portion which possesses a very black colour, with the consistence of syrup, contains, *Bimeconate* of *lime*, pure *Morphine*, *Narceine*, *Thebaine*, *Meconine*, pure *Narcotine*. In order to separate these substances, the liquid is brought to the consistences of molasses, and in order to free it from an immense quantity of a peculiar black substance, which is improperly termed fat, it is diluted with water acidulated with muriatic acid. The addition of the acid causes this matter to swim on the surface; it is then skimmed off; it contains much ulmine. Ammonia is next poured into the purified liquid, by which means, *Morphine* and *Thebaine* are precipitated. This deposit is dried, pulverized and treated with boiling ether. The *Thebaine* though little soluble in this liquid, dissolves. The ethereal solution is distilled when the *Thebaine* remains behind in the form of small reddish crystals. These are purified by dis-

* Ann. de Chimie, lix. 151.

solving them in alcohol, and by animal charcoal; lastly, in order to have it perfectly pure, it should be dissolved in ether and evaporated spontaneously.

The ammoniacal liquid is concentrated to the consistence of liquid honey, and agitated strongly with ether. The liquid dissolves the *meconine*. By distilling the ether this substance remains; it is purified by solution in water and charcoal, and when the aqueous solution is evaporated, white crystals of long prismatic needles make their appearance.

When we wish to obtain the other substances, all these processes are not necessary, it is sufficient after having precipitated the infusion of opium by muriate of lime, to concentrate the liquid and treat it directly with ether. By this means, rather more *meconine* is obtained. When the ether has ceased to act, the black liquid thus taken up is decanted and exposed in a cool place where it assumes a crystalline form; it is then expressed and treated with boiling alcohol. The product dissolved in this case is *Narceine*. But it is proper to state, that as this substance is not soluble in ether, and as the black substances which accompany it are soluble in alcohol, there are some difficulties accompanying the process for obtaining it; it is always procured pure by employing boiling water. No notice is here taken of *meconic acid*, which combines with the lime, and forms *bimeconate of lime*, because Robiquet has sufficiently explained the method of obtaining it.

With regard to the double muriate of *morphine* and *codeine*, it is dissolved several times in boiling water, passing it through charcoal in order to decolourize it, or decomposing it by ammonia, which precipitates almost all the *morphine*, and leaves in the solution the *codeine*, with a little morphine combined with the muriatic acid, constituting the salt of Gregory. The morphine is purified by the usual means.

The solution of the triple salt is evaporated until it appears about to crystallize; then caustic potash is added in excess, which precipitates the codeine and retains the morphine in solution; the solution is then heated slightly, and allowed to stand for a day. The codeine, which at first appeared as an oil, crystallizes. It may be purified by solution in ether or alcohol. The former is preferable; because, if it contains morphine, this will be a direct method of separating it. From 40 lbs. of opium Couerbe obtained by this process,

1	oz.	of meconine
$1\frac{1}{2}$	,,	codeine
$\frac{2}{3}$	,,	narceine
1	,,	thebaine
50	,,	morphine

He did not extract *narcotine*, which exists in the refuse of opium and is well known. These substances present the following appearances when agitated with sulphuric acid containing a little nitric acid. *Morphine* gives a brownish colour. *Codeine*, a green colour. *Thebaine* a yellow rose-colour. *Narcotine*, a blood-red colour *Meconine*, a turmeric yellow, then a red colour. *Narceine*, a chocolate colour.

THEBAINE crystallizes from an ethereal solution, in flat rhomboidal prisms, with a fine lustre, and white colour. It is strongly alkaline.

When exposed to the temperature of 266° it fuses, and becomes solid at 230°. Narcotine fuses at 338° and solidified at 266°. Codeine fuses at 302, and meconine at 194°.

The strong acids convert thebaine into recin, and when diluted form crystallizable salts. The following results were obtained by Couerbe:—

	Carbon.	Oxygen.	Hydrogen.	Azote.
Narceine, ..	56·818	31·900	6·626	4·656
Thebaine,..	71·976	15·279	6.460	6·385
Codeine	72·846	14·775	7·148	5·231

The *Paramorphine* of Pelletier was obtained by Thiboumery by treating the infusion of opium with slacked lime. He obtained by this means a clear liquid, and a precipitate containing much lime, which was treated with alcohol, and the solution gave, instead of morphine, this new substance, which appears the same as the *thebaine* of Couerbe.

The proportion of *morphine* in opium, Couerbe states may be determined in the course of two hours, by boiling the infusion of opium with an excess of lime, and passing the solution through a filter. If an acid be added, taking care not to add in excess, morphine precipitates.

DESCRIPTION OF A BAROMETER,

By C. Brunner of Bern.

Poggendorff's Annalen der Physik und Chimie.

Band, xxxiv. 1835.

The author observes that the atmospherical pressure may be measured in two different ways, either by observing the height of a liquid column contained in a tube, the upper part of which is deprived of air, and the lower extremity is exposed to the excess of the atmosphere, as in the common barometer, or by the volume which a gas occupies in a closed vessel, when the latter is completely elastic, or the act of enclosing the gas in the vessel is effected without perceptible resistance.

The apparatus of Varignon, described in 1705; the *sympiesometer* of Adie the *baroskope* of Prechtl, and the *differential barometer* of August, are examples of the latter. He then proceeds to describe an instrument which he has constructed upon similar principles, and which may be termed the *volume barometer*. The peculiarities of his contrivance depend upon having the surface of the liquid in the tube, and that surrounding it, on a level: that the liquid shall be of such a nature as to have no perceptible tension at common temperatures: that it shall not perceptibly adhere to the glass, lest a portion remain hanging in the tube, and the enclosed volume of air be undervalued: that all the observations be taken at the same temperature, or that the influence of the temperature upon the enclosed air be taken into account.

He recommends it as being very convenient for making the necessary reductions for gas mixtures.

ON ALTITUDE BAROMETERS OF THE MOST COMPLETE CONSTRUCTION, BY GEORGE BREITHAUPT, OF CASSEL.—The writer states that he has devoted much time to the perfecting of these important instruments. He describes his precautions for purifying the mercury, which he prepares from cinnabar, by distillation with lime. It is then strained through card paper many times, heated nearly to the boiling point, and filtered into the tube. The nonius scale he forms of the most delicate kind, extending to $\frac{1}{10}$ millimetre $\frac{1}{50}$ line and adjusts a microscope to it.

DESCRIPTION OF AN APPARATUS FOR ASSAYING SILVER, IN THE WET WAY, BY E. JORDAN, OF CASSEL.—This is somewhat similar to the apparatus described by Gay Lussac, in his work upon the assay of silver. It differs in this respect, however, that by the proceeding of Jordan the contents of an alloy are determined in the direct way.

OBSERVATIONS ON THE DECLINATION AND DAILY VARIATION OF THE NEEDLE AT PEKIN, BY Hr. KOWANKO, MEMBER OF THE IMPERIAL RUSSIAN MISSION AT PEKIN, COMMUNICATED BY A. T. KUPFFER.—The observations were made with Gambey's declination compass. The westerly declination was found to be for March 1832, 2º 15′ 42″. The westerly progress of the needle from December 1831 to March 1832, was 12′. At Petersburgh, during the same time the easterly deviation was 3′, where the total deviation was on the 22d and 23d December, 6º 27′ 5″, and on the 20th and 21st March, 6º 23′ 58″. Hrn. G. Fuss, who preceded Kownanko at Pekin, found the declination there in December 1830 1° 38′ W, in May 1831, 1° 55′ W, and in June 1831, 1° 48′ W.

The needle reached its easterly variation on 21st December at 9 A. M. On 22d December at 10 A. M. On 20th March at 9 A. M., and on 21st March at 9 A. M. While its westerly daily variation was as follows . 21st December, 2 P. M. var.= 4′ 10″ 22d December 2 P. M. var. = 2′ 20th March . 2 P. M. var· = 5′ 41″ 21st March . 2 P. M. var. = 6′.

MAGNETICAL OBSERVATIONS AT NERTSCHINSK, COMMUNICATED BY A. T. KUPFFER.—Cancrin found the inclination of the needle at this place, on the 5th August 1832, at 10 A. M. 66° 33′ 4″. The declination on 5th August, 2 to 4 P. M., was 4° 14′ 15″ W. 22d September 4° 7′ 43″ W.

ON THE MAGNETISM OF THE EARTH, BY PROF. L. MOSER, OF KONIGSBERG.—In a previous paper, Moser endeavoured to prove, from various data, that the magnetic intensity of the earth is situated on its surface. He follows up the subject in the present paper. He considers as demonstrated, that the magnetic distribution over the earth is proportional to the line of its breadth, and calculates the inclination and intensity. He also discusses the theoretical grounds from which the temperature of the earth has been calculated by mathematicians. He calculates the intensity to be in 54° 42′ 50′ N. L., 1·6037, and the inclination 71° 8′ 20′. The mean temperature of the northern hemisphere he finds 15° R. (65°¾) in the 30th° of latitude. That of the southern hemisphere is 63°. 34.

MAGNETIC INFLUENCE PRODUCED BY THE ELECTRICAL MACHINE.—M. Llambias, of Port Mahon, in a communication to the Academy of Paris, observes that magnetism can be developed in this way. The two electrical currents in a metallic conductor discharged from a Leyden jar, may be separated, at least, in part, by having the conductor adjusted so as to separate into two or more arms, which gives origin to a spark in any arc or part of the same, where the two currents unite in passing through ; it is in general the positive stream (that proceeding from the positive to the negative pole) which contracts the power of communicating the magnetic influence.

LIST OF EARTHQUAKES, VOLCANIC ERUPTIONS, AND REMARKABLE METEORIC APPEARANCES SINCE THE YEAR 1821, BY K. E. A. v. HOFF, 9TH PART.—This forms the concluding portion of an important list of meteoric phenomena, registered with considerable minuteness. It terminates with a summary exhibited in the following tables, comprehending 10 years, from 1821 to 1830 :—

	EARTHQUAKES.		VOLCANIC ERUPTIONS.	
	NORTH HEMISPHERE	SOUTH HEMISPHERE	NORTH HEMISPHERE	SOUTH HEMISPHERE
January	31	2	1	0
February	36	0	2	1
March	31	1	2	0
	98	3	5	1
April	29	1	1	2
May	33	3	0	0
June	33	1	1	0
	95	5	2	2
July	20	3	2	1
August	31	2	1	0
September	24	3	0	0
	75	8	3	1
October	41	2	1	2
November	26	1	1	1
December	34	1	4	1
	101	4	6	4
Total	369	20	16	8

From this table it appears that the occurrence of earthquakes in the different seasons was as follows :—

NORTH HEMISPHERE.

In the three harvest months	=	101
,, winter	,,	98
,, spring	,,	95
,, summer	,,	75

SOUTH HEMISPHERE.

In the three harvest months	=	5
,, winter	,,	8
,, spring	,,	4
,, summer	,,	3

In reference to the hours at which they took place during the same period, we have the following data for earthquakes :

	A.M.	P.M.
From 12 to 1 o'clock.	= 15	6
,, 1 ,, 2 ,,	11	7
,, 2 ,, 3 ,,	12	10
,, 3 ,, 4 ,,	14	13
,, 4 ,, 5 ,,	16	8
,, 5 ,, 6 ,,	11	6
	79	50
,, 6 ,, 7 ,,	= 6	5
,, 7 ,, 8 ,,	8	13
,, 8 ,, 9 ,,	7	11
,, 9 ,, 10 ,,	8	10
,, 10 ,, 11 ,,	18	8
,, 11 ,, 12 ,,	5	6
	52	53
Total....	=131	103

EARTHQUAKES AT BASLE.—According to Professor Merian, the earthquakes at Basle are correctly estimated as follow :—

In the 11th century,	3	In the 17th century,	59
,, 14th ,,	4	,, 18th ,,	24
,, 15th ,,	5	,, 19th ,,	4
,, 16th ,,	23		
		Total......	122

118 occurred in the different months, as follows : —

January	12
February	14
March	6
April	5
May	11
June	3
July	7
August	8
September	12
October	11
November	14
December	15

The most severe earthquakes were on the 18th October 1356, when 300 persons lost their lives ; on the 21st July 1416, 7th September 1601, and 17th November 1650.

Compounds of Ferro-cyanodides and Ammonia, by Dr. Bunsen, of Göttingen.

1. AMMONIA FERRO-CYANODIDE OF COPPER.—When a salt of copper is precipitated by ammonia, and an excess of the latter added, so as to re-dissolve the precipitate, if ferro-cyanodide of potassium be brought in contact with the solution, a precipitate is not immediately produced, but after standing for some time, or by boiling, a brown crystalline substance falls in fine scales. After drying, the substance forms a brownish yellow mass, which is soluble in ammonia, but not in water or alcohol. When heated in a glass tube it becomes first blue, then purple-red, and assumes a dark colour, but gives out no water. By caustic alkalies it is resolved into hydrate of copper, and ferro-cyanodide of ammonia ; and by acids into ferro-cyanodide of copper, and ammonical salt.

Dr. Bunsen found its composition to be, iron 13·20, copper 30·33, cyanogen 38·08, ammonia 16·14, water 2·25 = 2, 4, 6, 4, 1, atoms respectively. This composition may be expressed, considering the ammonia as occupying the place of water, by $2 \text{ Fe Cy} + 2 \text{ Cu Cy} + 4 \text{ N H}^3 + \text{HO} = 76{\cdot}125$ the atomic weight.

2. AMMONIA FERRO-CYANODIDE OF ZINC, is prepared in the same way as the preceding. It is a white crystalline powder. Analysis afforded for its composition, iron 13·15, zinc 32·27, cyanogen 39·04, ammonia 11·50, water 4·0 = $2 \text{ Fe Cy} + 2 \text{ Zn Cy} + 3 \text{ NH}^3 + 2 \text{ HO}$.

3. AMMONIA FERRO-CYANODIDE OF MERCURY.—The preparation of this salt is attended with some difficulty; because, ammonia nitrate of mercury dissolves nitrate of ammonia when excess of alkali is present. When Ferro-cyanodide of potash is added to this solution, a yellowish precipitate subsides, which, when the solution attains its proper degree of dilution, settles on the sides of the glass, in the form of small, transparent, shining, wine-yellow, four-sided prisms. But, in order to obtain them, several precautions are necessary. The solution must contain as little water as possible. The solution must not be too much concentrated, nor must the precipitation be conducted by heat, because part of the mercury will be reduced, and the product will have a gray colour. It is best to discover the necessary degree of concentration by some preliminary trials,—to precipitate the compound in a vessel surrounded by ice, and then to agitate the solution. A yellowish precipitate subsides, from which the supernatant liquor is to be removed, and a quantity of concentrated ammonia poured over it. As long as the salt is impregnated with ammonia it retains a fine citron-yellow colour, and crystalline structure. By drying in the open air it undergoes partial decomposition. When treated with water it becomes red. It consists of iron 8·58, mercury 59·09, cyanogen 23·74, ammonia 5·19, water 3·40 : expressed by $\text{Fe Cy} + 2 \text{ Hg Cy} + \text{NH}^3 + \text{HO}$.

4. AMMONIA FERRO-CYANODIDE OF MAGNESIUM, is procured by adding to a solution of magnesia salt, ammonia, till no further precipitation takes place, and then pouring in a solution of ferro-cyanodide of potassium. After standing or boiling, a white powder falls. It consists of iron 18·86, magnesium 10·72, ammonia 10·75, cyanogen 56·27, water 3.40 = $7\ (\text{Fe Cy} + 2 \text{ Mg Cy} + 5\ (\text{Fe Cy} + 2 \text{ NH}^3 \text{ Cy}) + 6 \text{ HO}$.

Another compound was formed by using ferro-cyanodide of calcium instead of the salt of potash. The constituents were, iron 18·24, magnesium 8·93, ammonia 11·43, cyanogen 53·91, water 7·49, abstracting the lime which was found in it. This is equivalent to (Fe Cy +2 Mg Cy) + Fe Cy + NH^3) + 2 HO.—*Records of Science*, 1835.

THE TRANSACTIONS OF THE LINNEAN SOCIETY OF LONDON. Vol. xvii. Part. I.

Contents.—I. Description of the organs of voice in a new species of wild swan (Cygnus Buccinator Richardson.) By W. Yarrell, Esq., F. L. S., &c.

II. Description of three British species of fresh water fishes belonging to the genus Lenciscus of Klein, by W. Yarrell, Esq., F. L. S., &c.

III. Observations on the Tropæolum pentaphyllum of Lamarck, by Mr. David Don.

IV. On the adaptation of structure of the Sloths to their peculiar mode of life, by Professor Buckland.

V. Observations on Naticina and Dentalium two genera of Molluscous animals, by the Rev. Lansdown Guilding.

VI. Monograph of the East Indian Solaneæ, by C. G. Nees Esenbeck, M. D.

VII. On the Lycium of Dioscorides, by J. Forbes Royle, F. L. S.

VIII. A review of the natural order Myrsineæ, by M. A. De Candolle.

IX. On the Modifications of Aestivation observable in certain plants formerly referred to the genus Cinchona. By Mr. David Don.

X. Additional Observations on the Tropæolum pentaphyllum. By Mr. D. Don.

All these papers, with the exception of the two last amounting to six pages, were read before the Linnean Society in 1832. The quality, however, of the materials of which this volume is composed does not produce the same disappointment which is experienced in reference to the quantity. We may refer more particularly to Esenbeck's Monograph, and the distinguished De Candolle's review, for the materials of both of which we are indebted to the industry of Dr. Wallick and the munificence of the East India Company. It is remarkable, however, that of 145 pages, of which the volume consists, 90 are written by foreigners. I conceive that a short outline of these papers will be highly acceptable to those who may not have an opportunity of reading the transactions themselves.

THE PAPER OF ESENBECK TREATS OF TWO NATURAL ORDERS, VIZ. SOLANEÆ AND VERBASCINÆ, IN REFERENCE TO INDIAN SPECIES.

SOLANEÆ.

I. SOLANUM.

I. *Maurella.*—A Pedicles equal to the common peduncle.

1. S Fistulosum; 2. S Incertum *syn* nigrum; B Pedicles of the fruit, shorter than the common peduncle; 3. S Rubrum.

2. *Geminifolia.*—4. S Spirale; 5. S membranaceum; 6. S leave; 7. S denticulatum; 8. S bigeminatum; 9. S Neesianum; 10. S crassipetalum; 11. S decemfidum; 12. S macrodon; 13. S lysimachioides.

3. *Verbascifolia.*—14. S verbascifolium; 15. S auriculatum; 16. S giganteum; 17. S vagum.

4. *Melongena.*—18. S melongena; 19. S heteracanthum.

5. *Torva*, (acute lobed leaves.)—20. S Wightii; 21. S barbisetum; 22. S ferox; 23. S torvum; 24. S Indicum; 25. S jacquini; 26. S procumbens; 27. S sarmentosum; 28. Strilobatum.

6. *Nycterium.*—29. S (nycterium) pubescens.

7. *Pinnatifolia.*—30. S tuberosum; 31. S calycinum.

20. Has been named in honour of the indefatigable Dr. Wight of Madras, who for some time has employed painters and collectors at his own expense, for the purpose of elucidating the botany of Madras.

25. Under this species Esenbeck includes the S *diffusum* of Roxburgh. It is an abundant plant in Madras and Bengal, and I have found it occurring plentifully in the neighbourhood of Bombay.

30. This merely refers to the potatoe as cultivated in Madras and Bengal. It does not attain any considerable size in the hot parts of these presidencies, but near Bussorah I believe it thrives much better.

II. LYCOPERSICUM *Dun.*

1. L esculentum; 2. L Humboldtii.

III. CAPSICUM *Linn.*

1. C grossum; 2. C fastigiatum; 3. C frutescens, the *Tschili or Chili*; 4. C chamaecerasus.

IV. PHYSALIS *Linn.*

1. P somnifera; 2. P Peruviana; 3. P pubescens; 4. P minima; 5. P angulata; 6. P Indica.

V. ANISODUS *Lin.*

Luridus.

VI. DATURA *Linn.*

1. D alba; 2. D fastuosa; 3. D trapezia; 4. D ferox; 5. D stramonium; 6. D tatula.

VII. NICOTIANA.

N tabacum. *Hab.* near Katmandoo.

VIII. HYOSCYAMUS.

H Niger. *Hab.* near Futteghur, Moradabad, Delhi.

VERBASCINAE.

I. VERBASCUM thapsus. *Hab.* near Gossain Than in Nepaul.

2. V Indicum. 3. V *spec. dub.*

II. CELSIA coromandelina. 2. C Viscosa.

III. ISANTHERA permollis.

The paper of De Candolle does not require such a minute analysis as the species of the order *Myrsineæ*, which he has therein illustrated, are all natives of foreign climates, and cannot, therefore, be so generally interesting as those of the order of *Solaneæ*. A few facts may, however, be stated, which exhibit in a striking point of view the rapid progress which

botany is at present making in regard to the discovery of new species.

The order *Myrsineae* is now placed between the orders *Sapoteae* and *Primulaceae*, from the latter of which it seems to differ in the indehiscence of its fruit, and from the former by the constant deficiency of stamen alternating with the lobes of the corolla. This order is divided by the author into three tribes, 1. Aegicereae, with an erect embryo; 2. Ardisiae, including the bulk of true Myrsineae; 3, Mœseae, with an inferior ovarium, approaching to primulaceae.

He has proposed two new genera, Weigeltia and Conomorpha, and a third, Choripetalum, which has not been sufficiently examined. The species of this order produce a resinous substance, which appears in the form of dots or reservoirs, in different parts of the plant, chiefly on the leaves, flowers, and berries, and also in the hard wood of the Myrsine and Aegiceras. It melts and burns in the flame of a candle, is not soluble in water, but is so in oil or alcohol when moderately heated, giving to the latter a rose colour, These facts were particularly observed in the berries of the *M. semiserrata*. The dots are dark or light brown, reddish or yellow, varying in size, shape and position, in different species. The fruit of *Embelia ribes* possesses a styptic taste, which the author supposes to depend on this resinous substance.

Of 180 species of *myrsineae* 58 are described for the first time by the author. They grow commonly on the hilly and mountainous regions of the hottest parts of the globe. None have yet been found beyond the 39th or 40th degree of latitude, viz. in Japan, whilst they abound in Java and in some parts of India and South America. No species is known in Africa except at the Cape and at the Canary Islands, Mauritius, Bourbon and Madagascar. The 180 species are distributed as follows: 112 in Asia and New Holland, 48 in America and 20 in Africa.

Mr. Don, in his paper, shews that the form of aestivation of the corolla is of great importance as a character to distinguish different families, especially among the monopetalous orders, except in the order *Rubiaceae*, where examples of every kind of modification occur. In the Cinchona *grandiflora and rosea* it is imbricate, in C *lanceolata* and the rest of the true cinchonae it is valvate, while in the West Indian species it is in duplicate and in the *Cexelsa* plaited. Of the genus cinchona he enumerates seventeen true species. 2. Combuena, (C grandiflora) two species; *obtusifolia* and *acuminati*; 3. Lasionema (C rosea) *roseum*; 4. Exostema, seven species; 5. Hymenodictyon (C excelsa) *excelsum and thyrsiflorum*; 6. Luculia *gratissima* and *cuneifolia*; 7. Pinckneya *pubens*.

DON'S OBSERVATION ON THE TROPAEOLUM PENTAPHYLLUM OF LAMARCK.—The other paper of Mr. Don is upon the Tropaeolum pentaphyllum of Lamarck, which has been introduced into this country by Mr. Neil of Edinburgh. He shews that it differs from the genus Tropaeolum in having the aestivation of its calyx valvate, that of Trapaeolum being imbricate. In the nature of its fruit, which is a black juicy berry resembling the Zante grape, and in the reduced number of its petals. He has formed it into a new genus, and terms it Chymocarpus *pentaphyllus*. Its calyx is persistent, while that of Tropaeolum is deciduous. The embryo is small and white, contained in a thin cartilaginous testa, and the cotyledons round and compressed. It belongs to the natural order Tropaeoleae, and is a native of the sandy plains of Buenos Ayres. It was first observed by Commerson, and afterwards by Tweedie.

MR. ROYLE HAS ENDEAVOURED TO IDENTIFY THE PLANT TERMED LYCIUM BY DIOSORIDES.—The *lycium* of Asia Minor he considers may be made from the Rhamus *infectorius*, or different species of Rhamnus, or the Berberis *vulgaris*. The *lycium* of India, again, he identifies with the produce of the Berberis *aristata*, occurring on Choor mountain, 5000 to 8000 feet high, called in *Arabic* Amburbarees, in Persian Zirishk, the *Wood* darkhuld and darchob, the *extract* hooziz, the hill name being chitrach, and also with the extract obtained from the B *lycium* growing at Mussooree, 3000 to 5000 feet of elevation, called *Kushmul*, the extract *rusot*.

This *rusot* can be procured in every bazar in India, and is used by the native practitioners in chronic and acute inflammations of the eye, both simply and combined with alum and opium. It was employed by Mr. M'Dowell in the Egyptian ophthalmia, and Mr. Royle has applied it with beneficial effects in cases succeeding acute inflammation. The extract is rubbed to a proper consistence with a little water, sometimes with opium and alum and is then applied in thick layer over the swollen eyelids. The addition of a little oil renders the preparation less desiccative.

It is mentioned in the *Mukhzun-ool-udwieh*, (store house for medicines) under the name of *loofyon*, which is obviously the same as *lookyon* of the Greeks. Dioscordies describes it as being formed from a shrub called *Lonchitis*, which is thorny, and has branches three or more cubits in length, whose bark, when bruised, becomes of a reddish colour and whose leaves resemble those of the olive. In these respects Mr. Royle's plant agrees with that of Dioscorides. Indeed we have rarely seen a more plausible deduction from etymology than is exhibited in the present instance. It is to be regretted, however, that the *rusot* has not yet found its way into chemical hands.

COMPARATIVE ANATOMY, &c.—Mr. Yarrell describes the organs of voice in the Cygnus *buccinatur*, a new species of swan, figured by Dr. Richardson, from the interior of the fur countries of North America. This species, which is called the Trumpeter, furnishes the largest portion of the supply of swan skins imported by the Hudson's Bay Company. Its beak is black; trachea is made up of narrow bony rings and

small intervening membranous spaces as far as the first convolution within the sternum; but the returning portion of the tube, forming a second convolution, is composed of broader and stronger bony rings, with wider intervals. The course of the trachea within the sternum differs from that of the hooper, after descending by the neck it passes backwards within the keel, and between the two plates of the back bone to the depth of six inches, then curving horizontally and slightly inclining upwards, returns at first by the side of and afterwards over the first inserted portion near two thirds of the whole distance. A second curve of this returning portion is then suddenly elevated two inches above the line of the superior surface of the keel, and traverses the interior of a hollow circular protuberance on the dorsal surface of the sternum itself. The usual ascending curve of the trachea then takes place, by which the tube, ultimately receding, grains the interior cavity of the breast. The bronchiae are two inches long. Such are the peculiarities which characterize this new species.

TWO SPECIES OF LEUCISCUS, OR DACE FAMILY OF FISH, ARE DESCRIBED BY MR. YARRELL, ONE OF WHICH, L. LANCASTRIENSIS, WAS MERELY NOTICED BY MR. PENNANT AS LIKELY TO BE NEW UNDER THE NAME OF GRAINING. IT IS MORE SLENDER THAN THE DACE.—In the latter the length is to the depth as 4 to 1, but in the graining as 5 to 1. The head and back are of a pale drab colour, tinged with red; irides, yellowish-white; the fins pale yellowish-white. In the dace the back and sides yellowish olive-coloured, tinged with blue; lower fins pale red, with a smaller number of fin rays in some fins, in others less. It occurs in a stream which rises in Knowsly Park, in the Mersey and in the Alt. L. elongatus, pinna dorsali supra pinnas ventrales posita, caudali profunde biloba, capitis lateribus supra subparallelis ore parvo, dorso lateribusque superne subrufescenti, isabellinis inferne ventreque argenteis.

The other species, L *cœruleus* is quite new. He gives it the English name of Azurine. Its depth is to its length as 7 to 2, resembling the *red eye* in shape, but is easily distinguished from that species by the silvery whiteness of the abdomen, which in the *red eye* is of a brilliant golden orange, and also by its white fins, which in the other are vermillion. L ovato-lanceolatus, pinna dorsali pone pinnas ventrales posita, dorso plumbeo, ventre argenteo, pinnis albis.

B 3 D 10 P 16 V 9 A 12 C 19.

MR. GUILDING OBSERVES THAT THE NATICIDAL FORM A VERY DISTINCT EAMILY FROM THE NERITIDAE.—The former are apparently blind, the operculum has no appendages; their useless tentacula are weak and turned back on the shell, while in the act of creeping the head and its organs are perfectly veiled by a broad expended hood, the sensible contractile apex of which serves to guide its motions. at first sight they rather resemble the *Bullidae*.

He describes and figures two species of Dentalium, viz. D *Semistiolatum*, and D *Sowerbyi*. Very little is known with regard to this genus. M. Deshayes had previously thrown some light on its history, but its position in the natural system is not yet made out. Mr. Guilding is inclined to place it near *patellae*. It resembles in its vent the genus *fissurella*, in its apical fissure the posterior marginal rima of *emarginula*.—*Records of Science*, 1835.

OBSERVATIONS ON THE FORMATION AND CHANGES OF THE INFERIOR ORDERS OF PLANTS BY F. J. KUTZING.*

The nature of the lowest species of plants is a subject of interest. M. Kutzing, from many observations which he has made upon them, has drawn some important results.

Distilled water remained stationary for six months, without shewing any appearance of green matter on its surface. Water which had been distilled over plants presented a different aspect.

In some of them a mucus began to shew itself in the course of eight days; in rose water in about two weeks. First the mucus is deposited, and the characteristic odour of the water disappears. Hence, this mucilage would appear to be formed at the expense of the essential oil. No filaments or globules can be discovered at this stage; but if the water is less exposed to the direct influence of the sun, they appear at first colourless in the mucous mass, and then the different forms of *Hygrocrocis* and *Leptomitus* shew themselves. This constitutes the second step; the light of the sun determining whether *Protococcus* or *Hygrocrocis* shall be developed. The lowest state of these globules is well exhibited in the genus established by Kutzing, of *Cryptococcus* which is inferior to *Protococcus*; for in the former the organic mucus is only observed in the form of minute globules, while in the latter, they are larger and possess colour with a more solid texture. The third step is the formation of filaments, by the union or elongation of the colourless globules, giving origin to *Hygrocrocis* or *Leptomitus*. The *Leptumula* is an advanced state of *Cryptococcus*. The latter is formed in moist windows. Kutzing has observed the formation of an *Oscillatoria* which he calls *fenestralis*, over a stratum of *Cryptococcus*, which previously became a *Palmella*. If we term the transformation of *Cryptococcus* into *Hygrocrocis* and *Leptomitus* a direct progressive step, we may call that of *Cryptococcus* into *Palmella* and *Protococcus*, latterally progressive.

It is worthy of remark, that the *Protococcus* is often found in dry places, for it seems that it never appears in water except when the sun is shining on it, and the *Hygrocrocis* and *Leptomitus* appear in the shade. It has been observed that the algæ (algues) are formed after the death of the *Infusorii*, especially the *Enchelys pulvisculus*. When the water in

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* Ann. des Scien. Nat. II. 129.

which this animal is found, is evaporated, the latter contracts after death into globules. These possess at first their transparency at the extremities, which correspond to the head and tail; but gradually they contract into a ring surrounded by other globules, and assume an appearance resembling *Protococcus*; only it is mucilaginous when united in large masses, and is therefore more like *Palmella*.

At this time an *Oscillatiria* begins to appear, which Kutzing terms *brevis*. It is always the same plant. The author confirms the accuracy of the observation of Treviranus with regard to the motion of the sporules of algæ. He observed the motions of millions of globules while examining the *Draparnaldia plumosa* in a glass of water. Under the microscope he noticed, that as the green border (which was formed on the second day after depositing the plant in water), increased, the filaments of the *Draparnaldia*, lost their green colour and became hyaline, and the globules resembled then the *Cymbella* (Frustu'ia.) These movements somewhat resemble those of pollen in spirit of wine, camphor in water, &c., but they are of longer duration. By keeping a *Protococcus* which was seated on sandstone constantly wet, the globules became connected, filaments were formed, and a conferva produced, which he calls *tenerrima* (*C Muralis* Spreng.) This plant is found in the waters of reservoirs, and is transformed into an alga of a superior order, the *Inoderma*. Kutzing observed the *Alysphæria flavo-virens* to be produced from the *protococcus viridis*, by the conversion of the globules into dichotomous filaments.

He found likewise, that by examining the structure of the *Parmelia parietina*, it is observed, that the globules of the *Protococcus viridis* which occurs on trees along with the lichen, enter into its frond, and that the latter is the first state of the lichen. Upon the upper part of trunks of trees, we observe the *Parmelia parietina*. At the base we notice filaments of *Protonema*, which are generally converted into *Orthotrichum*, *Hypnum* and other mosses.

Kutzing has distinctly observed these threads of *Protonema* formed by globules of *Protococcus*. These globules swell, being filled in the interior with a green liquid, and are gradually expanded into filaments. It appears that the formation of *Alysphæria* does not necessarily precede that of the lichens, but that it is an independent structure. Kutzing observed the *Barbula muralis* a moss, produced from *Protonema* and also from a *Protococcus*. The genera *Zygnema* and *Mongeotia* are generally found in shallow water. When the water containing these plants is evaporated, the *Conferva quadrangula* appears From the *Mongeotia genuflexa* in this way proceeds the *Ricciá crystallina*. From his observations Kutzing infers:—

1. The formation of organic matter cannot take place, except from elements of other organic principles already dissolved.
2. Simple globules (*Cryptococcus Palmella* and *Protococcus*), may produce different plants according to the influence of light, air and temperature.
3. The superior algæ are plants of very simple structure.
4. The same superior structure may be produced from original structures altogether different. Thus, the *Barbula muralis*, is formed from the *Protonema* which comes from a *Protococcus*, and again proceeds from the remains of the dried *Palmella botryoides*, without passing through the stage of *Protonema*.—*Records of Science*, 1835.

ON MALT.

By Rorbet D. Thomson, M. D.

At a time when so much excitement exists in regard to the subject of Malt, it will not, perhaps, be considered a superfluous undertaking if I attempt to lay before my readers an outline of the process to which grain is subject before it acquires this designation.

A knowledge of the peculiarities of this interesting process is important in a double point of view, because it affords a remarkably beautiful specimen of the chemistry of nature, and because its product forms a staple commodity of British manufacture, no less than forty millions of bushels of malt being annually consumed in the United Kingdom, which, at 60s. per quarter, exceeds in value the large sum of £ 24,000,000, and contributes a revenue to Government at 2*s.* 7*d.* per bushel of more than £ 5,000,000 per annum.

It would throw no light upon the chemical nature of malting if we were to endeavour to investigate the history of its discovery, because the changes which grain undergoes during the stages of the process, are not yet fully developed; and we are, therefore, led to infer that the introduction of this preparatory step to fermentation was the consequence of some accidental observation.

It is sufficiently well known indeed that the method of inducing the vinous fermentation was understood at a very early period. Thus the Chinese distil *samshoo*, an ardent spirit, (and we are sure that any practice which exists among them is of very high antiquity) from rice and the roots of plants, and the savages of the Pacific Ocean prepare a similar product from the masticated roots of herbs.

The Abyssinians have long been in the habit of fermenting the husks and stones of grapes, and distilling the brandy which is highly concentrated through a hollow cane called *shambacco*.* And the Germans, at the earliest period to which their history carries us, were so partial to fermented liquor, that they believed if they obtained the favour of their divinity (Woden) by their valour, they should be admitted after their death into his hall, and reclining on couches, should regale themselves with beer from the skulls of their enemies whom they had slain in battle.†

But for these objects malting is not necessary, for even in this country much spirit

* Pearce's Travels, i. 237.

† Hume's History of England, i. 31.

is made from raw grain. The quantity of grain consumed in this way amounted, in 1834, to 6,694,344 bushels.

We may consider the subject, first in reference to its physical nature, or the process of malting, and secondly in an economical point of view, or the duty on malt.*

I. PROCESS OF MALTING.

Any kind of grain may be converted into malt, but in this country there are three species of plants belonging to the order *Cereales* which are peculiarly employed for this purpose. These are Hordeum *distichum*, H. *vulgare*, and H. *hexastichon*.

1. The H. *distichum* is what is commonly termed *barley*,† and is characterized by having two lateral rows of seeds which are imbricate. The average length of a seed is 0.343 inches. Breadth 0.143 inch. Thickness 0.108 inch.

2. H. *vulgare* Linn. in herb. Errh. Pl. Off. 421. Herb. Davall. 1802, described by Linneus as having two rows of seeds more distinct, but there are two additional imperfect ones. The length of a spike of average grain is 3 inches. Length of a seed .375 inch. Breadth 0.16 inch.

It is to this species that the name *bigg*, I believe, is more peculiarly applicable. The term is one employed by the country people in Scotland, who are not in general, as elsewhere, very precise in their definitions, and are apt to apply one term to different species. Indeed, the whole of the species are often indiscriminately called *bear*, a mixture being often sown which is termed *blended bear*.

3. H. *hexastichon*, Linn. Spec. Plant. 125. Hort. Ups. 23. This species is described by Linneus as posessing universally hermaphrodite flowers, with the seeds placed regularly in six rows. The seeds in my specimen were in length .325 inch. in breadth .15 inch. and much inflated and rounded on the external surface. Length of the spike 1.7 inch. I have been favoured with the authority of an extensive farmer for identifying this species with the Scotch *bear*. "*Bigg*," says he, "has four rows on the head, two of which are better than the others and contain also more grains. *Bear*, has six rows, is a strong coarse grain and be easily known after separation from the straw, by its thick husk and long awn." The first of these distinctions may be a tolerable criterion, but the latter is decidedly not so, because in Irish specimens which I possess, the awns of the H. *vulgare* are much longer than those of the H. *hexastichon*. It is, therefore, a matter of great doubt whether in all cases these species of grain can be distinguished after separation from the straw.

The correct discrimination of these species is of great importance, because the quality of the malt is inferior in the two latter. From the experiments made in 1806 by order of Government, it appears that the value of barley is to bigg as 100 to 89½, taking the mean of the value of English and Scotch barley as the standard; but if we considered the Scotch barley still as of inferior quality to the English, then the relations will be as in 1806, English barley 100, Scotch barley 93, Bigg 86; or the malt of *bigg* is 14 per cent. inferior to that of English barley, and 7 per cent. inferior to that of Scotch barley. Their relative values may, perhaps, be better appreciated by attention to the product of spirit derived from each. Thus the quantity of proof spirits per quarter of each, exhibited in the following table:

	Wine measure.	Imperial measure.
English Barley	20.79 gallons.	17.20 gallons.
Scotch Barley	20.02 ,,	16.70 ,,
Scotch Bigg	18.96 ,,	15.72 ,,

They differ also in respect of weight, so that the quality may be in some measure detected by this test. The average weight of each kind of grain is represented as follows:

	lbs. avoird.		Imperial measure.
English Barley	49.871	per Winchester bushel.	51.444
Scotch Barley	49.754	,,	51.327
Scotch Bigg	47.352	,,	48.849

From experiments, it appears that the grain does not lose any weight by keeping. After an interval of six months, the difference of weight scarcely ever amounted to $\frac{1}{100}$th, and this was generally in favour of the grain which had been kept longest.

If we inquire into the natural history of these different species, we shall be able to throw some light upon the causes of the difference in the value of their grain.

(To be continued.)

* See Papers presented to the House of Commons in 1799, 1804 and 1806.

‡ Through the kindness of my friend Mr. Don, I have had an opportunity of identifying this and the following species with the specimens in the Linnean herbarium.

TRAVELLING LIFE-APPARATUS.

Sir,—The accompanying drawings represent a travelling life-apparatus, the intention of which is, to combine in one expeditious travelling carriage every means which can contribute toward the salvation of the lives of shipwrecked mariners.

It consists of a life boat gun for having lines—a catamaran for clearing surfs—and a carriage for the conveyance thereof; which last can be used for the transportation of anchors and cables, scaling-ladders for cliffs, and in war for defence of the coast. It might also be used for the purpose of accompanying armies, and enabling them to cross rivers; uniting, in one machine, the baggage-waggon, pontoon, and gun-carriage.

The models (of which the accompanying are correct drawings) have been already laid before several of the public boards; and I have been endeavouring for these two years to get it adopted, but without success.

An invention on such a subject should not be kept a secret, particularly at this stormy

seson of the year, when the dangers of our coast are so much aggravated, and call so loudly for every means which can be used to ameliorate the horrors of shipwreck. Will you, then, assist me in giving it additional publicity, by recording it in the pages of your valuable Periodical ?

Iam, Sir, yours obliged,
HENRY DUNCAN CUNNINGHAM.

Gosport, March 28, 1835.

P. S.—I shall be much pleased to see my machine noticed by some of your French subscribers. I am informed, they are at present forming stations along their northern coasts.

DESCRIPTION OF THE ENGRAVINGS.

Fig. 1 is the life-carriage with its appendages, ready for travelling. The interior construction of the boat A A may be understood by the dotted sectional view : *f f* is a platform parallel with the line of floatation, which is taken when the boat is fully manned and equipped. From this platform are tubes which communicate with the water, through the bottom. There are two of these tubes between each thwart, one upon each side, and close to the keel, and by them any water the boat ships runs out again. But to enable the boat to free herself as soon as possible, increased buoyancy is given by all the parts not occupied by the rowers and setters, being fitted in with a casing of wood, flush with the thwarts, and covered with fine painted or oiled duck. The boat is on the dimensions of a 10-oared cutter. A hollow copper, or tin gun-wale streak, is carried round the outside, capable of holding several gallons of air. By these precautions, the danger of swamping is entirely removed, and the difficulty of capsizing so great, as to permit the boat to right when the keel is nearly parallel with the surface of the water. The midship tubes are advantageously employed for the purpose of weighing or carrying anchors, the fall being led through them to a windlass also placed amidships.

On the hindmost axletree of the carriage are two levers, of which G is one. The head of the bolt, or linch-pin, is so constructed as to form the fulcrum to another large lever B, equal to the two smaller ones G G. The linch pin is represented by the dotted figure at C. The parallelogram which hides it from view is the end of one of the magazines for supplying ammunition to the carronade O, intended to heave lines to ships in distress. By means of the levers the boat is attached to the carriage, and they are so proportioned as to allow one man at each small lever, and two men at the large one, to heave the boat up. The ends are secured by the rope F, and the ring-bolt *d; b* and *a* are slings attached to the boat. A better idea of the formation of the carriage, &c. may be conceived by fig. 2.

The process of working the apparatus is this :—In attaching the boat to the carriage the latter is wheeled over the former, and the slings in the sides and stern of the boat hooked to the levers, which are then hove down and secured. The whole operation might be done in a few minutes, and in a reversed manner with the same speed.

The gun is used by withdrawing the linch-pin C, thus detaching the shaft E from the fore-axletree, the end of which being allowed to go upon the ground prevents recoil. A line is then fired, and a communication established between the ship and the shore—if

Fig. 1.

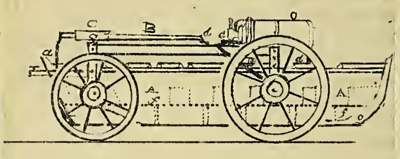
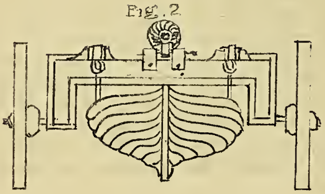


Fig. 2.



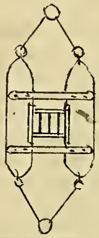


Fig. 4.

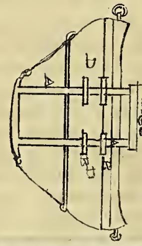


Fig. 3.

the distance is great, by means of the life-boat, but if through much surf by the catamaran, which would in that case be the safest mode.

There are many parts of the coasts of England which consist of long flat bays, in every part of which ships are liable to go on shore, or be in distress ; for instance, White-Sand Bay, near Plymouth, which extends for ten or twelve miles. Now, a life-apparatus cannot be stationed at every part of this distance ; consequently, the only way which such a place can be supplied effectively, is to have a machine which can be transported to any part, and any distance, with facility and speed.

Suppose a life-machine, on this plan, were stationed at Looe, and a vessel is observed to be in distress in the middle of the bay.

The carriage would be dispatched with all expedition, and in a short time arrive at the spot. But, in the interim, the ship has gone on shore, and in such a situation that the only way of communicating is by means of a rope. In a few minutes the boat is detached from the carriage, the gun brought in operation, and a line having been fired, the people are taken out, by means of the catamaran, before the vessel goes to pieces Many other examples might be adduced, which will appear evident to those who are acquainted with the dangers of a sea-coast.

Finally, for war and defence of the coast, this apparatus would be eminently useful. Suppose each intermediate coast-guard station were furnished with a life-carriage, and that an attack from boats were anticipated at any point, by means of signals, a brigade of guns, served by the station men, might in a short time be formed, sufficiently strong to repulse even a very serious attack. Again, in the event of an army campaigning in a country intersected by rivers; and of their requiring not only artillery, but means to pass the aforesaid rivers, a brigade of these machines, with flat-bottomed boats, would answer the purposes of both. By heaving lines across a floating bridge might in a time be constructed, thus superseding the use of pontoons. The guns of the carriages might, if required, be employed to cover the landing.

THE CATAMARAN.

The catamaran consists of two copper boats, strongly joined together, as in fig. 4. Between them is an iron cradle (see fig. 3). D D is the interior view of one of the boats; A A is one of the frames of the cradle, furnished at the bottom with a flat iron sledge, and sliding freely in the slides B B. The bottom of the cradle is grated, and upon this the man stands: his weight being thus considerably below the line of floatation, or the centre of gravity, and the two boats acting in opposition to each other, the possibility of upsetting is almost entirely removed.

As the catamaran is represented in fig. 3. it is afloat; but when it takes the ground the cradle slides up, and the bottom coming on a level with the bottom of the boats, its passage over sand or shingle, when being beached, is very easily effected.

After the line from the gun has taken effect, the catamaran is hauled off by those on board, another rope attached to it being held by those on shore.

The catamaran will hold two or three persons, and is placed or carried in the life-boat when the machine is travelling. If used at night, a light may be attached to it, as in the life-buoy.

H. D C.

THE PNEUMATIC RAILWAY.

(Continued from page 63.)

It is well known that notwithstanding the prosperous condition of the Manchester Rail Road Company, yet their expenditure in locomotive power has been so enormous as to cause considerable anxiety on the part of the Managers; and some of them have even inclined to the opinion, that the question of stationary power deserves to be reconsidered. This opinion would probably be confirmed and strengthened, if the practicability of the pneumatic system were satisfactorily demonstrated by experiment upon a sufficiently large scale.

On the whole, it appears to me that if the mechanical difficulties of maintaining the pneumatic tunnel sufficiently air-tight be overcome, the system presents a fair prospect of being practically successful. These difficulties are not so great as they may at first appear. It should be recollected that nothing approaching to the *exhaustion* of the tunnel can be necessary; nor even any considerable degree of rarefaction. Supposing the tunnel to have an internal diameter of 40 inches, the impelling diaphragm would have surface of about 9 square feet. If in such a tunnel a degree of rarefaction were produced sufficient to cause a parometric gauge to fall 2 inches (which would be an extremely slight degree of rarefaction indeed), an impelling force would be obtained amounting to one pound on every square inch of the surface of the diaphragm, which would give an impelling force of more than half a ton. It is calculated that on the common railways the amount of load is above 200 times the force of traction, and it would therefore follow that this force would be sufficient to draw a load of 100 tons. If an additional inch of mercury be made to fall in the barometric gauge to balance friction, &c., still the rarefaction would be extremely inconsiderable, and the contrivances to prevent leakage would appear to be attended with no great mechanical difficulty.

From the various reasons which I have above stated, I am of opinion that the present project would, if carried into execution, be likely to be attended with greater economy and safety than any other method of working railways now practised; and I see no reason against the attainment of as much speed as is obtained by the locomotive engines. At all events, having explained the season on which I have grounded this opinion, every one can judge to what weight it may be entitled. The project would appear to be well deserving of trial on some railroad of limited length, such as that between London Bridge and Greenwich, where it would be sufficient to have stationary engines at the extremities. In such a case, I see scarcely any limit to the speed which might be attained with safety; and the economy, as compared with locomotive engines, would probably be very great.

DION. LARDNER.

London, Feb. 19, 1835.

OPINION OF PROFESSOR FARADAY.

Mr. Hocking to Professor Faraday.

44, Berners-street, Jan. 26, 1835.

Dear Sir,—As you have witnessed the experiment upon the improved or pneumatic system of railway, and expressed a highly gratifying opinion of its merits, I am anxious to be permitted to cite you as an authority on those important points on which you can speak most confidently, and on which alone its practical application depends.

The efficacy of the power is, of course, indisputable; and it is but to witness the experiment, as you have done, to admit that the mode of its application which this improvement embodies is equally simple and certain.

To put the power which nature supplies in action, and apply it to the object, local steam-engines are employed, as these yield the services of the gigantic force of steam in the cheapest possible manner. Local steam-engines possess, moreover, this further important and valuable quality, that the intensity of the force may be greatly varied upon them, so that they may be worked at a low pressure for levels and descents, and be increased in their effect to almost any extent to work acclivities.

The possession of the means of increasing the active force as the occasion may require, obviates the necessity of obtaining a level, or even a near approach to a level; and as it is this necessity which involves the enormous expense of cutting down or tunneling through hills, and of embanking across valleys, for the locomotive system, the advantage of obviating it needs only to be pointed out to be admitted.

In the mechanical construction of the railway, whilst the cylindrical form which is given to the body, and its inflexible continuity, make it independent of artificial foundations, the attachment of the rails to the cylinder upon its horizontal diameter gives them the important advantage of being at once inseparably connected, and totally independent of extraneous or artificial support.

Besides the general stability which the peculiar form and mechanical construction of the improved railway give it, the system upon which it is worked renders it free from any tendency to derangement, since the carriages run along upon the rails with the even and unexciting pressure of the load alone; and this system employs no ponderous locomotive-engine, whose violent concussions might promote any such tendency, nor is the railway burdened with an incumbrance which wastes upon its own unprofitable weight a large proportion of the power it brings.

The attachment of the governor, or external carriage of the travelling apparatus, to the dynamic traveller within the body of the railway, and its connexions with the railway itself, are such as to preclude the possibility of its being thrown off: and as the train of carriage must follow the governor, and every carriage has its peculiar attachment, their security is absolute. Indeed, it appears to me difficult to suppose an accident arising from the railway itself, or from the mode of transit, or that could happen to either, that could have the effect of rendering the carriages insecure, or even affect in the slightest degree their safety.

I do not trouble you with questions as to the costs of formation and construction, as that is a mere matter of estimate;—the fact that the power employed is capable of being increased at pleasure, to overcome acclivities, shows an important saving in the most expensive item; and in working a railway, the difference between the expense of local and locomotive steam-power alone, is so beyond all comparison in favour of the former, that no one at all conversant with the subject will require evidence of the great advantage in point of economy to be derived from its use.

Your confirmation of the correctness of the views herein stated will much oblige,

Dear Sir,

Your faithful servant,

William Hocking.

Michael Faraday, Esq., F. R. S.,

&c. &c. &c.

Professor Faraday to Mr. Hocking.

Royal Institution, Feb. 3, 1835.

My dear Sir,—The points in your letter of the 26th of last month, which you put to me for an opinion, are such that I have no hesitation in agreeing with you upon *them.*

To enumerate briefly these points:—the *principle* of communication of power is correct—the use of local steam-engines is highly advantageous, both for cheapness of force, and capability of varying it when required—the necessity for levels will, I presume, therefore be greatly obviated—the association of cylinder and rail is such that the whole road must (with sufficient thickness in the cylinder) have great strength and firmness—the absence of locomotive-engines removes much of the cause of derangement which the road would have to sustain—and I do not see how the governor and carriages can leave the railway.

You know my objection to giving a general opinion in reference to the profitable application of the plan in question; but I may here add, that the reserve I feel originates simply in my possessing no *practical* knowledge of the construction, expense, and profit of ordinary railroads.

I am, my dear Sir,

Very truly yours,

M. Faraday.

William Hocking, Esq. F. A.,

&c. &c. &c.

ON CALICO-PRINTING.

By Thomas Thomson, M. D., F. R. S. L. and E. &c. &c.

Regius Professor of Chemistry in the University of Glasgow.

(*Continued from page* 64.)

III.—RESIST PASTES.—These are substances which have the property of restoring the blue colour of dissolved indigo, and thus, of preventing it from becoming fixed on those parts to which the resist-pastes have been applied. Any substance which the property of readily parting with oxygen, answers this purpose. *Sulphate of copper*, or any salt containing black oxide of copper, when put into the indigo vat, instantly revives the indigo, by communicating oxygen to it. The hydrated black oxide of copper has the same effect, and so have the sesquioxide and deutoxide of manganese.

The calico-printer's indigo vat is a very deep large vessel filled with water, into which indigo, sulphate of iron, and an excess of lime are put. The lime decomposes the sulphate of iron, and the disengaged protoxide of iron coming in contact with the indigo at the bottom of the vat, deprives it of an atom of oxygen, and thus renders it capable of combining with the lime, and of forming a compound which dissolves in water, and forms a yellow liquid. Where this solution is in contact with the atmosphere, the indigo is revived, assumes its blue colour, and loses its solubility. Hence, the blue scum which always covers the surface. But this scum, in some measure, protects the rest of the vat. When cloth is dipt into this vat it comes out yellow. But from the exposure, the indigo gradually absorbs oxygen and becomes blue. The cloth at first, from the mixture of the blue and yellow, has a green colour, which slowly deepens into blue. But if, to any parts of the cloth before it be dipped into the vat, something has been applied which has the property of giving out oxygen to the indigo; all the indigo which would be imbibed by these parts is revived, before it comes in actual contact with cloth; and, in the revived state, it is incapable of combining chemically with the cloth, but may be easily washed off. Hence, the parts covered by *resist-pastes* remain white.

The following are the principal resist-pastes used by calico-printers:

1. BLUE PASTE OR VITRIOL consist of a mixture of sulphate and acetate of copper, and the solution is thickened with gum-senegal and pipe-clay for the block, and with flour, for the cylinder. When the cloth on which this paste has been printed is dipt into the indigo vat, the indigo is revived before it has time to reach the surface of the cloth. After dyeing, the piece is passed through weak sulphuric acid, to remove the oxide of copper which has been precipitated on it.

2. MILD PASTE consists of sulphate of zinc, gum, and pipe-clay. It is used along with colours which copper would injure, or which would be destroyed by immersion in sulphuric acid. It resists a pale blue and the removal of the oxide of zinc by an acid, is not necessary, as it is when copper has been employed.

Sulphate of zinc, as well as all the other metallic salts and all the acids, precipitates indigo from its solution in lime. It does not revive the indigo like the salts of copper; but when the base of indigo is precipitated, it is not so readily fixed as a state solution. The oxide of zinc with the gum and pipe-clay, acts mechanically in keeping it at a distance.

3. RED PASTE consists of the alum mordant already described, mixed with acetate of copper, gum, and pipe-clay. It resists pale blues, and the alumina remains upon the white portions of the cloth, to be afterwards dyed *red*, with madder or *yellow* by quercitron bark.

4. NEUTRAL PASTE is a name given by printers, to a compound of lime juice, sulphate of copper, gum, and pipe-clay. It resists during a short dip in the blue vat; and the lime juice gives it the property of remaining white when the piece is dyed in madder, even when the preceding *red paste* goes over it. This acid also prevents the lime of the blue vat from precipitating copper upon the cloth, which would cause the parts to assume a deep brown tinge when dipt into the madder vessel.

5. CHROME YELLOW RESIST PASTE consists of a mixture of a salt of copper, to resist the blue vat with a salt of lead, to produce a yellow with bichromate of potash, after having been dyed in the blue vat.

The preceding observations were necessary, to give the reader an idea of the various processes, followed by the calico-printers, and with the rationale of them. I shall now proceed to explain the different colours. And both the simplest and most intelligible method of proceeding seems to be, to place pieces of printed calico before the eyes of the reader, and describe the way in which the colours on them have been produced. We shall begin with the simplest colours, and proceed gradually to more complex ones.

1. MADDER RED.—The alum more mordant described above, is made into a paste, and printed on the cloth by the cylinder. After being dried and exposed in a warm room, till the alumina has had time to leave the acid with which it was united, and combine with cloth, it is passed through a hot mixture of cow's dung and water. It is then washed in cold water, and agitated a second time in the same hot mixture. After being thus freed from all soluble or loose matter, it is dyed in madder. This process consists in the exposure of the cloth to the action of madder, suspended in water. In consequence of the very sparing solubility of the colouring matter of that root, and the difficulty of applying it equally to all parts of the cloth, the process requires to be conducted slowly, and the heat to be very gradually raised. The purest portion of the colouring matter being first given out by the madder, the degree of heat

is varied, according to the fineness of the colour we desire to obtain.

After dyeing those parts of the cloth intended to be white, are always, more or less, tinged with the madder, and much pains are necessary to restore their purity. For this purpose, boiling with bran, or with soap, exposure to light upon the grass, clearing with chloride of lime, or other substances, which have the property of dissolving or destroying this colouring matter, with repeated washings in cold water, are all resorted to according to circumstances. And several of these operations have the additional effect of brightening the red, by abstracting a brownish matter, which always combines with the alumina, at the same time with the red colouring matter.

(To be continued.)

PROGRESS OF SCIENCE.

By the recent arrivals we have received our Journals up to January 1836, on Science and the Arts. The following are among the interesting articles from which we have already made a Selection, and shall make others next month.

Experimental researches into the laws of the motion of floating bodies. By J. S. Russell.

On an economic application of electromagnetic forces to manufacturing purposes. By Robert Mallett.

On a new rotative steam-engine. By John Taylor, Esq.

On the simultaneous vibrations of a cylindrical tube, and the column of air contained in it. By the Rev. James Challis.

On recent experiments made to protect tin plate, &c , from corrosion. By Edmund Davy, F. R. S., &c.

Donisthrope and Rawson's improvements in the combing of wool, &c. (with an engraving).

Taylor's improvements in instruments for measuring angles and distances, applicable to nautical purposes (with an engraving).

Whiteside's improvements in wheel of steam carriages, and in the machinery for propelling the same (with an engraving).

Losh's improvement in the surface or pattern roll of the surface printing machines, and in the mode of working them (with an engraving).

Carter's improved apparatus for regulating the supply of gas to the burners, and for stopping off the same, &c. &c. (with an engraving).

Leeming's improvements in water-wheels and paddle wheels (with an engraving).

Potter's improvements in rendering fabrics water proof.

Hudson on certain machinery applicable in block printing on silk, &c., and on paper (with an engraving).

Boydell on improvements in machinery for tracking or towing boats or other vessels (with an engraving).

Schafhautl's improvements in the manufacturing malleable iron.

Garner's improvement in the art of multiplying certain drawings, &c.

ON SOME RECENT EXPERIMENTS MADE WITH A VIEW TO PROTECT TIN PLATE OR TINNED IRON FROM CORROSION IN SEA-WATER, WITH SOME PROBABLE APPLICATIONS; AND ON THE POWER OF ZINC TO PROTECT OTHER METALS FROM CORROSION IN THE ATMOSPHERE. BY EDMUND DAVY, F. R. S., M. R. I. A., &c., PROFESSOR OF CHEMISTRY TO THE ROYAL DUBLIN SOCIETY.—If a piece of tin plate is exposed in sea-water for a few days, it will exhibit an incipient oxidation, which will gradually increase; the tin will be preserved at the expense of the iron, which will be corroded. But if a small surface of zinc is attached to a piece of tin plate and immersed in sea-water, both the tin and iron will be preserved, whilst the zinc will be oxidated, on the principle first made known by the late Sir H. Davy.

The author has exposed for nearly eight months in sea-water a surface of tin plate nailed to a piece of wood by means of tinned iron tacks, inserting between the wood and the tin plate a small button of zinc. Under these circumstances the tinned plate has remained clean and free from corrosion; the zinc has of course been corroded. In a comparative experiment, in which a similar piece of tin plate was nailed to the same piece of wood, and exposed during the same period to the same quantity of sea-water, without the zinc, the edges on two sides of the tin plate were quite soft from the corrosion, which had extended to about one-eight of an inch. These experiments seem worthy of being repeated and extended.

The present demand for tin plate is very great; should these statements be confirmed, a vast increase in its consumption might be anticipated. The opinion may be entertained that it is practicable to substitute double tin plate for sheet copper in covering the bottoms of ships, &c., using zinc in small proportions as a protector. Such applications would probably occasion a saving of nearly three-fourths of the present expense of copper sheating.

It also seems deserving of inquiry, whether tin plate vessels, protected by zinc, may not be advantageously substituted for copper vessels in many of our arts and manufactures, and even in domestic economy. Although it might be presumed, from Sir H. Davy's experiments and observations*, that zinc would protect tin plate from corrosion in sea-water, the author is not aware that any direct experiments on the subject have been published. Sir H. Davy briefly refers to some obvious practical applications of his researches, to the preservation of finely divided astronomical instruments of steel by iron or zinc; and that

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* *Phil. Trans.*, vol. cxiv , for 1824; [or, *Phil. Mag.*, first series, vol. lxiv., p. 30, 233; vol. lxv., p. 203.—EDIT.]

Mr. Pepys had taken advantage of this last circumstance, in inclosing fine cutting instruments in handles or cases lined with zinc. The author has not heard whether such applications have succeeded, but he has made a number of experiments with a view to protect brass, iron, copper, &c., from tarnish and corrosion in the atmosphere by means of zinc; the results obtained, however, lead to the conclusion, that contact with zinc will not protect those metals in the atmosphere, the electricity thus produced, without the intervention of a fluid, being apparently too feeble to counteract the chemical action of air and moisture on the surfaces of the metals*.

EXPERIMENTAL RESEARCHES INTO THE LAWS OF THE MOTION OF FLOATING BODIES. By J. S. RUSSELL.

It was the object of these inquiries to assist in bringing to perfection the theory of Hydrodynamics, and ascertain the causes of certain *anomalous facts* in the resistance of fluids, so as to reduce them under the dominion of known laws.

The resistance of fluids to the motion of floating vessels is found in practice to differ widely from the theory, being in certain cases, double or triple of what theory gives, and in other and higher velocities, much less. These deviations have now been ascertained to follow two simple and very beautiful *laws*:—1st. A law giving a certain *emersion* of the body from the fluid as a function of the velocity. 2nd. A law giving the resistance of the fluid as a function of the velocity and magnitude of a wave propagated through the fluid, according to the law of Lagrange. These two laws comprehend the anomalous facts, and lead to the following

RESULTS.

1. That the resistance of a fluid to the motion of a floating body will rapidly increase as the velocity of the body rises towards the velocity of the wave, and will become greatest when they approach nearest to equality.

2. That when the velocity of the body is rendered greater than that due to the *wave*, the motion of the body is greatly facilitated: it remains poised on the summit of the wave in a position which may be one of stable equilibrium; and this effect is such that at a velocity of nine miles an hour the resistance is less than at a velocity of six miles behind the wave.

3. The velocity of the wave is independent of the *breadth* of the fluid, and varies with the square root of the *depth*.

4. It is established that there is in every navigable stream a certain velocity at which it will be more easy to *ascend* the river against the current than to *descend* with the current. Thus, if the current flows at the rate of one mile an hour in a stream four feet deep, it will be easier to *ascend* with a velocity of eight miles an hour on the wave, than to *descend* with the same velocity behind the wave.

5. That vessels may be propelled on the summit of waves at the rate of between twenty and thirty miles an hour.—*Proceedings of the British Association at the Dublin Meeting, August*, 1835. *Lond. & Edinb. Phil. Mag.*, vol. vii., p. 302.

ON AN ECONOMIC APPLICATION OF ELECTRO-MAGNETIC FORCES TO MANUFACTURING PURPOSES. BY ROBERT MALLETT.

—The separation of iron from brass and copper filings, &c., in work-shops, for the purpose of the refusion of them into brass, is commonly effected by tedious manual labour. Several bar or horseshoe magnets are fixed in a wooden handle, and are thrust, in various directions, through a dish or other vessel containing the brass and iron turnings, &c., and when the magnets have become loaded with iron, it is swept off from them by frequent strokes of a brush. This is an exceedingly troublesome and inefficacious process.

It appeared to the author that a temporary magnet of great power, formed by the circulation of an electric current round a bar of iron, might be substituted advantageously. The following is the arrangement which he has adopted. Several large round bars of iron are bent into the form of the capital letter U, each leg being about six inches long. They are all coated with coils of silk-covered wire in the usual way of forming electro-magnets of such bars, and are then arranged vertically, at the interval of five or six inches from each other.

All the wires from these coils are collected into one bundle at their respective poles, and there joined into one by soldering, a large wire being placed in the midst of them and amalgamated. A galvanic battery is provided, which, if care be taken in making the junctions at the poles, &c., need not exceed four, or, at most six pairs of plates of from twenty inches to two feet square. The poles of this terminate in cups of mercury, which are so placed that the large terminal wires of all the coils can be dipped into them, or withdrawn easily.

The rest of the arrangement is purely mechanical. The required motions are taken from any first mover, usually a steam engine. The previously described arrangement being complete, a chain of buckets is so contrived as to carry up and discharge over the top of the magnets a quantity of the mixed metallic particles: most of the iron adheres to the magnets, while the so far purified brass falls into a dish or tray placed beneath to receive it. This latter is also one of a chain of dishes, the horizontal motion of which is so regulated that the interval between two dishes is immediately under the magnets, in the interval of time between two successive discharges of the mixed particles on the bars.

At this juncture the communication between the galvanic battery and the magnets is in-

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* [The negative results thus obtained by Mr. H. Davy, agree exactly with those of some trials which I have witnessed for protecting steel by this means.—E. W. B.]

terrupted by withdrawing the wires from the cups of mercury, and the result is, that the greatest part of the adhering iron drops off and falls in the space between the two dishes. The next dish now comes under the magnets, the communication is restored, and a fresh discharge from the buckets takes place, and so the process is continued.

Some iron constantly adheres to the magnets, but this is found of no inconvenience, as it bears but a small proportion to the total quantity separated.

The author has had an imperfect apparatus of the sort above described at work for some time, and has found it to answer; and suggests the application of electro-magnets for somewhat an analagous objects in various manufactures. He particularly mentions needle and other dry grinding.—*Proceedings of the British Association: Lond. and Edinb. Phil. Mag.*, vol. vii., p. 305.

ON A NEW ROTATIVE STEAM-ENGINE OF INCREASED POWER, CONSTRUCTED BY MR. SIMS, BY JOHN TAYLOR, ESQ., F. R. S., TREAS. G. S., &c.—It is very well known to those who have observed the duty of steam-engines employed in the mines of Cornwall, that an enormous difference has existed between those which raise water by a reciprocating motion, and those which for other purposes have that motion converted into a rotative one by the intervention of a crank. The cause of this difference has often been speculated upon, but has not, I believe, been well explained: it is important in an economical point of view, as while in the pumping engines sixty millions pounds are commonly raised one foot by each bushel of coal consumed, the rotative engines for stamping ores have seldom raised more than twenty millions, and those for winding up the ores from under ground are found to be even far below this in effect.

Now, it should be observed, that the pumping engines are at present universally, I believe, single engines, that is to say, receiving the steam from the boiler on one side of the piston only, the principle of working double, as it is called, which was introduced by Mr. Watt, having been for some time discarded; and in these single engines the method of working high pressure steam expansively, which we owe to Mr. Woolf, has long been used with the greatest advantage.

The rotative engines in Cornwall, like all others which are used for manufacturing purposes, are double engines, and receive the steam alternately above and below the piston; and though attempts have been made to work them expansively, these attempts have not been very successful.

The object of my present address to you, is to notice an engine which has lately been constructed for a mine in which I am interested, which is a rotative one for stamping tin ores, and which, when I visited the mine a few days since*, was calculated to be performing a duty of about sixty millions, or nearly equal to the average of the better class of reciprocating engines, and nearly three times, as much as the best rotative engines have hitherto done.

I wish to call the attention of persons concerned in the use of steam-engines to this fact, because if it should be found that this rate of duty can be maintained, a very great improvement may take place in all such as are most generally employed.

This engine is at work at the Charles Town united mines, near St. Austle; it was erected for us under the direction of Mr. Sims, an engineer of great experience in Cornwall. It differs from the general construction, in being a single engine, having the beam loaded at the outer end; and the rotatory motion of the crank is rendered almost completely uniform by the assistance of the flywheels. It works nearly as expansively as the pumping-engines.

It was predicted, I understand, before the engine went to work, that a steady rotative motion could not be produced in this way, and some believed that the crank would never pass the centre; I can, however, bear witness that the action is extremely good, and will, I believe, by a little alteration in the weight and diameter of the fly-wheels, be made perfect; and as it must be an object to save at least one half the fuel ordinarily consumed, I point it out as deserving attention and inquiry. I have desired that its performance may be regularly reported in the monthly duty papers.

I am informed by Captain Thomas Lean, who reports the duty of most of the engines in Cornwall, that this is not the first construction of the kind, but that a similar one was erected formerly at Wheal-Vor tin-mine, by Mr. Peter Godfrey, and that it then surpassed in duty any other stamping engine of its day, but that for some reason it never attracted much notice.

Mr. Sims is constructing a winding-engine for the same mine, on a similar principle.—*Lond. & Edinb. Phil. Mag.*, vol. vii., p. 369.

ON THE SIMULTANEOUS VIBRATIONS OF A CYLINDRICAL TUBE AND THE COLUMN OF AIR CONTAINED IN IT. BY THE REV. JAMES CHALLIS.—Mr. Challis, in his report on the Analytical Theory of Hydrodynamics, and elsewhere, has expressed the opinion that to complete the theory of musical vibrations in a cylindrical tube, it is necessary to take into account the vibrations of the tube itself.

In this communication he states some results which he has arrived at theoretically, respecting the kind of influence the tube will exert on the aërial columns.

It is assumed that the tube is capable of vibrating so that its particles move in planes perpendicular to the axis, with the same motion in all directions from the axis, in the same transverse section. Then, if the vibrations of the tube be of very small extent, and

* Mr Taylor's letter is dated "Bedford Row, Oct. 12, 1835."—A. T.

its diameter small, compared with its length, the following are the principal mathematical results respecting the motion of the air, so far as it is consequent upon the vibrations of the tube.

1. The motion of the particles situated on the axis will take place in the direction of the axis, and will be nearly the same as if an impulse were originally given in this direction, and the propagation were rectilinear.

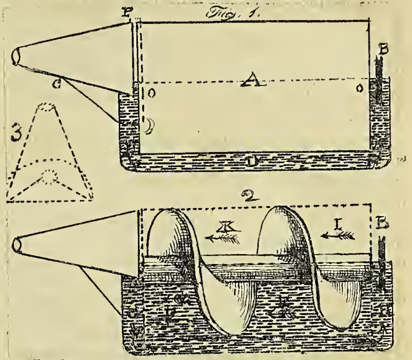
2. At all points of the same transverse section, the motion, estimated in a direction parallel to the axis, will be nearly the same.

3. If the tube be made to vibrate isochronously, and so as to contain, at equal intervals along its length, nodal sections and sections of maximum vibration, it will produce in the fluid vibrations of the same duration, with points of quiescence and of maximum vibration at intervals corresponding to vibrations of that duration in *air*.

4. But unless the nodal sections of the tube be fixed, the duration of these simultaneous vibrations will not be permanent till the intervals between the nodal sections become the same in the tube as in the column of air: and then a nodal section of the tube is nearly coincident with a section of maximum vibration of the fluid.

From these results it follows that there are certain transverse vibrations of the tube which will impress on the fluid column the same kind of motion as it is known can be given to it by vibrations excited near one extremity of the tube, when the other is open. Mathematicians have succeeded in satisfactorily representing the circumstances of the motion in the latter case of disturbance, by assuming, from experiment, that the open end is a position of maximum vibration, or nearly so; but hitherto no distinct cause for this fact has been assigned. Mr. Challis thinks it may be shown mathematically, that the aërial vibrations, excited at the extremity of the tube, and propagated along its interior, will put it into the state of vibration, which, as appears from the foregoing results, will produce an effect the same in *kind* as that observed. But to what *degree* the phænomenon may be attributed to this cause, can be learnt only from experiment; by ascertaining whether the vibrations of the tube have any considerable influence on the intensity of the musical sounds. The following fact seems to favour the idea of a sensible influence. A sound produced under glass (for instance, the ticking of a French clock under a glass covering), is *louder* than when the glass is removed, plainly by reason of the internal reflections and the propagation of the vibrations along its surface, which cause it to vibrate so as to act with increased effect on the external air. It is not easy to discern that the glass vibrates, but the increase of sound is proved to be owing to this cause, when, on pressing the glass with the palms of the hands, the intensity is diminished. This experiment may suggest the means of detecting the influence of the vibration of a solid, in other instances of a similar nature.—*Proceedings of the British Association: Lond. and Edinb. Phil. Mag.*, vol. vii., p. 300.

HYDRAULIC BLAST-WHEEL.



In founderies, smithies, and other manufactories, large quantities of atmospheric air in rapid motion are in constant demand, and a large proportion of the motive power is spent in the supply. The pressure of fluids being equal in all directions, the aggregate amount of force employed in transmitting air by means of bellows, air-cylinders with pistons, &c., is very considerable, there being the same pressure on every square inch of the blowing-apparatus, as on the like space of the orifice through which the air is transmitted.

The accompanying drawings represent a blast-wheel lately invented by me, of which the following is a description. I have had a model of it made, and it fully verifies the correctness of my calculations; and in this case the effects must be the same in proportion on a large scale.

Fig. 1. A is a hollow cylinder (the length of twice its diameter), which is made to revolve on the pivots O by means of a rope or belt acting on the pulley B, or by any other mechanical power. C is a stationary nose or tube, fixed to the side of the oval trough D. The trough is nearly full of water, its level being above the centre of the cylinder A, and of the small cylinder within it, hereafter described. Within the cylinder A is a spiral leaf wound round a cylinder of about $\frac{1}{5}$th of the diameter of the external one. The size of the internal cylinder need not be increased in proportion to that of the external. The leaf is soldered to both cylinders, and so rendered air-tight; it may be made of the slightest material.

Fig. 2. The water is here seen occupying the lower half of the cylinder and trough, the top being always filled with air. On the wheel's making one revolution, the *water* in E is conveyed into F; that which was before in F escapes at G, and flows round the sides and bottom of the trough, outside the cylinder, to re-enter the latter at H. The air in I (which is continually supplied by atmospheric pressure of 15 lbs. to the square inch) is conveyed to K, and so in proportion for less than a revolution; and the air which was before in K is forced through the pipe at C, to which branch-pipes may be attached. A continuous blast of air is thus produced, and may be conveyed to any part of a building. The pressure

of the water being equal on all sides; and as it is set in motion by the inclined plane of the screw, but little power is required to keep the wheel going, for the particles of fluids move easily amongst themselves. The trough should be of an oval form. In order that no air may escape between the tube and the cylinder, a small strap of leather is fastened to the tube (which is fixed) to lap over the cylinder at P, fig. 1, and is kept down by a small weight, hung at the corner of each side, thus. No air, once enclosed or detached from the atmosphere by the end H of the spiral leaf being immersed in the water, can possibly escape but through the nose or tube.

Fig. 3. Transverse sections of both ends of tube; and outline, as seen from its under side.

The wheel may be made of any size required. To ascertain the quantity of air discharged at each revolution:—first, find the whole contents of the cylinder, which we will suppose to be 14 feet in diameter, by first finding the area of the base by multiplying the square of the diameter by ·7854; then multiply the area by the length of 28 feet, thus, $14 \times 14 = 196 \times \cdot 7854 = 154$, nearly, $\times 28 = 4312$ contents of cylinder. But as it takes two revolutions to empty the cylinder, $4312 \div 2 = 2156$ feet of air and water discharged at each revolution, $2156 \div 2 = 1078$ feet of air less 78 feet for internal cylinder, &c. $= 1000$ cubic feet of air discharged at every revolution. If the motive-power, or the velocity, cannot be easily regulated, a sling-valve may be made in the side of the tube C.

Alfred T. J. Martin.

Helston, Cornwall, June 6, 1835.

P. S.—Since writing the above, a practical difficulty has been suggested to me, viz., that the pressure of air for smelting should be 2, 3, and even 4lbs. to the square inch, equal to the pressure of a column of water about 7 feet high. I do not see how this desideratum can be obtained by the foregoing plan; but still the invention may prove useful where large supplies of air are required without any considerable pressure.—*Mechanic's Magazine*, 1835.

BRITISH ASSOCIATION.

GEOLOGY AND GEOGRAPHY.—A memoir was read by Captain Denham, on the basins of the Mersey and Dee:—

The paper was regarded by every one as of extreme value, and was received with great enthusiasm. We regret we can merely refer to it with great brevity, but we understand it will be speedily made public. He showed the difference between the horizontal impetus of running water, and its force when acting downwards by pressure. Channels had been opened to receive the tide, being more perpendicular to its course, and yet the tide had capriciously avoided them and no mud had been deposited. By many experiments and observations, he has determined, that while the high and low water levels are variable, the height of the mean tide or half tide is the same at all times; a fact of the highest importance, both in a scientific and practical point of view. Let us hope that future observations may speedily confirm this matter, and thus give us a secure standard as a base line for all our measurements.

DR. REID DELIVERED HIS VIEWS UPON A PLAN TRIED AT EDINBURGH, FOR THE EXTENSION OF THE STUDY OF PHYSICS.—He proposed to have large classes formed for observing chemical experiments, and that nothing should be employed in these experiments which were not easily procurable by every person. A bit of glass as glaziers throw away, a piece of charcoal, and a blow-pipe, would be instruments enough with which to make from one hundred to one thousand experiments, and these would illustrate the essential operations of chemistry. By this means a peculiar knowledge would be obtained, and the mode of conducting an examination on a small scale. Dr. Reid here made some experiments on a small piece of glass, and afterwards on paper, showing the formation of crystals, &c., and the effects were as distinctly marked as could be desired. He recommended that the pupils should write down on paper, at the time, the changes observed by them during the experiments. Dr. Reid then made some beautiful experiments, by applying tests to different liquids and solids. He took some lead ore, and adding nitric acid to it, myriads of little globules were at once reduced from the ore, and fell upon the paper. At the termination of each experiment the persons present were handed the specimens. The lecturer said, that a common beer-bottle with a tube, and another bottle for a receiver, would answer for the preparation of gases, and the conducting of operations on a small scale was the better to the student, as the substances passing from one state to another were distinctly seen in a simple apparatus. From calculations made in different places, he found that from 2*l.* to 5*l.* would provide apparatus and materials sufficient to show many thousand experiments. The great object was to render this department of knowledge accessible to all persons; and, as to the time its study should be commenced, he (Dr. Reid) would say from three to nine years of age would not be too early. This species of information was easier of acquisition than that of language. The greatest difficulty with children was to arrest their attention, on account of the liveliness of their sensations, and obstruct subjects were not sufficient to excite interest. Objects in external nature they observed, and were ready to attend to any instruction afforded in reference to them. The lecturer then noticed the necessity of persons devoting a short time to informing themselves of the principal practical results of chemistry in relation to the knowledge of the purity of water, the component parts of agricultural materials, &c. This species of knowledge would be of the highest utility to the emigrant, and by imparting it to the natives of the district in which he located himself, he would be elevating the character of his own countrymen, and receiving the friendship and support of strangers.

FOREIGN VARIETIES.

PROOF OF FRENCH SILK.—The French have adopted a system of security against fraud in the sale of silks, by submitting it to examination and experiment in an establishment called the *condition*. Silk exposed to a humid atmosphere, and yet more to wet, will imbibe a considerable quantity of humidity without undergoing any perceptible change in external appearance. The establishment, of which there is one at Lyons and another at St. Etienne, receives about three-fourths of the whole consumption of silk. It is submitted during twenty-four hours to a temperature of from 18 to 20 degrees of Reaumur (72½ to 77 of Fahrenheit), and if the diminished weight be from 2½ to 3 per cent, the application of the high temperature is continued during another twenty-four hours. On a certificate granted by the *condition* as to its true weight, the invoice is made out. The means of correctly ascertaining the real humidity of silk are now the subject of investigation at Lyons, and it is believed that the purity of the material will, ere long, be as accurately tested as is that of metals by an assay. The quality of silk is estimated by deniers, which represent the weight of 400 ells would off of on a cylinder; the number, of course, increases with the fineness. The Alais silk is sometimes reeled from three to four cocoons, and weighs only from eight to ten deniers; sometimes from seven to eight cocoons which will give eighteen to twenty deniers. Of French organzines, the quality varies principally from twenty to thirty-six deniers, and of French trams from twenty-six to sixty deniers.—*Dr. Bowring's Report*.

THE SUBMARINE VESSEL.—The experiment with this machine took place at St. Ouen, as proposed. The vessel was repeatedly sunk to the depth of ten or twelve feet, and re-appeared on the surface at different points. M. Godde de Liancunrt got into it, and remained there a quarter of an hour. He stated that he did not experience the least inconvenience, or any difficulty of respiration, during his voyage under water. An official report upon the subject is about to be submitted to the French Government.

USEFUL ARTS.

IMPROVEMENTS IN THE STEAM-ENGINE.—Mr. Price of the Durham glass-works, has published a plate of a steam safety-valve and chest, which has been in constant use for upwards of seven years, without accident. The following is a brief description of his apparatus, which, if we mistake not we had the pleasure of noticing when it was first used:—Instead of the common valve, there is placed on the top of the steam chest a cup, with an apperture for the steam to escape. In this cup a loose brass ball (weighed to the pressure the boiler can bear) is placed. When the steam rises about that pressure, the ball also rises, and allows the steam to escape through the waste. There is an elbow-pipe connected with the steem-chest below the ball-seat, which also enters the waste-pipe. In this is a handled valve, by which the engineer can blow off his steam, or regulate it. Let it be perfectly understood the ball cannot be weighed by the engineer; so soon as the steam rises above the safety-pressure, it escapes, and when sufficiently blown off, the ball returns to its seat.

SUBSTITUTE FOR STEAM.—The following plan has been addressed by Mr. John Galt to the editor of the *Greenock Advertiser*:—Take a cylinder and subjoin to the bottom of it, in communication, a pipe; fill the pipe and the cylinder with water; in the cylinder place a piston as in that of the steam-engine, and then with a Bramah's press, and a simple obvious contrivance which the process will suggest, force the water up the pipe, the pressure of which will raise the piston. This is the demonstration of the first motion. Second, When the piston is raised, open a cock to discharge the water, and the piston will descend. This is the demonstration of the second motion, and is as complete as the motion of the piston in the cylinder of the steam-engine, and a power is attained as effectual as steam, without risk of explosion, without the cost of fuel, capable of being applied to any purpose in which steam is used, and to an immeasurable extent. The preservation of the water may, in some cases, be useful, and this may be done by a simple contrivance, viz. by making the cock discharge into a conductor, by which the water may be conveyed back at every stroke of the piston into the pipe, at the end of which the Bramah's press acts.

ELECTRIC LIGHT.—Mr. Lindsay, a teacher in Dundee, formerly lecturer to the Watt Institution, succeeded, on the evening of Saturday, the 25th ult., in obtaining a constant electric light. It is upwards of two years since he turned his attention to this subject, but much of that time has been devoted to other avocations. The light, in beauty, surpasses all others; has no smell, emits no smoke, is capable of explosion, and not requiring air for combustion, can be kept in sealed glass jars. It ignites without the aid of a taper, and seems peculiarly calculated for flax houses, spinning-mills, and other places containing combustible materials. It can be sent to any convenient distance, and the apparatus for producing it may be contained in a common chest.—*New Monthly Magazine, Oct.* 1835.

QUICK AND CHEAP MODE OF RAILWAY TRANSIT WITHOUT LOCOMOTIVE-ENGINES.

Mr. Editor,—A great deal has been said on both sides for and against the undulating railway principle, but hitherto no satisfactory practical results have been obtained on which to found a definitive judgment respecting it; and although the shareholders of the Liverpool and Manchester Railway are deriving considerable profits, owing to the immense traffic between the two towns, still there are doubts if many other roads will pay at all, the expense of locomotive-engines being so

great wherever there are considerable inclines to be overcome, and the first expense of constructing the railway so enormous, from the endeavours made by tunnelling and embanking to reduce that expense. I am, therefore, induced to send you a new plan of an undulating railway, by which locomotive engines (except on very rare occasions, indeed,) will be dispensed with; the trains will travel by the force of their own gravity from station to station, as described in the following diagram:—

E E are stationary steam-engines, and O O O O inclined planes by which the stationary engines bring the trains up to a level; when the trains, going and returning, take the roads the arrows point to. I have no doubt but in many situations falls may be obtained each way for miles together. Deep cutting and tunnelling would be thus, in a great measures, dispensed with; and if tunnels in some situations were absolutely necessary, by giving them the required falls for the trains to go through them, by gravity alone, travelling through them would not be disagreeable, as no engine would go with the trains.

I am, Sir, your obedient servant,

THOMAS DEAKIN.

Blaenavon Iron Works, June 5, 1835.

MR. WOODHOUSE'S ANGULAR RAILWAY BARS.

Fig. 1.

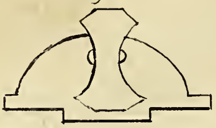
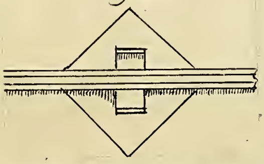


Fig. 2.



Sir,—As the form of rails best suited for affording safety, economy, durability, &c. has occupied the attention of many scientific persons, and formed the subject of several communications in your pages, I hope, without presumption, I may be permitted to propose the following as a plan, in my humble estimation, calculated to effect these objects.

Some few months since (No. 572), I proposed the use of an angular rail; my plan was not then matured, but as I have since given some little attention to the subject, I send you the results.

The purpose of giving an angular shape to the rail is, that the engine wheel (also having an angular grooved rim to correspond) may have a greater hold upon the rail, thereby giving greater efficiency to the power of the machine, preventing an irregular action, which must be produced when the wheel slips on the rail (a circumstance much alluded to at the opening of the Selby Railway), and thereby much strain to the machinery. The top surface, one inch broad, is intended for the train-wheels, and where friction would be a defect, it is thereby avoided. The form of the rail is intended to admit of being reversed at any future time when the upper surface is worn. The chair is not intended to be fixed, but the central part, which projects downwards, is to let into the stone sleeper, and be bedded in with cement or not, as found best. The rail is not fixed to all the chairs, but only to the centre one; which proposition I made with another plan of Rail and Chair sent to the *London and Birmingham* Railway Directors. The size of the present rail is as follows:—Depth, $4\frac{1}{4}$ inches; extreme width, $2\frac{1}{4}$ inches; surface, 1 inch; angles, from 15 to 25°, as the friction is required; the calculated weight is rather more than 51 lbs., but upon shrinking, it would probably not be more than 50lbs. to the lineal yard.

It has been objected to turning the rail when one side is partially worn down, that in proportion as it is so worn, its strength must be diminished. But as long as the internal structure of the rail is not so permanently injured as to prevent its return after deflection to its original horizontal form, it seems to me that it must be nearly, if not to the fully, as efficient as ever.

As respects the supporting of the rails, I also proposed that instead of having the rail resting solely upon the chair, the chair should be so planned, that the rail should also rest upon the surface of the stone, whereby it would be strengthened, and the stone, by receiving a steady vertical pressure, would be rendered less liable to the casualties so frequently complained of.

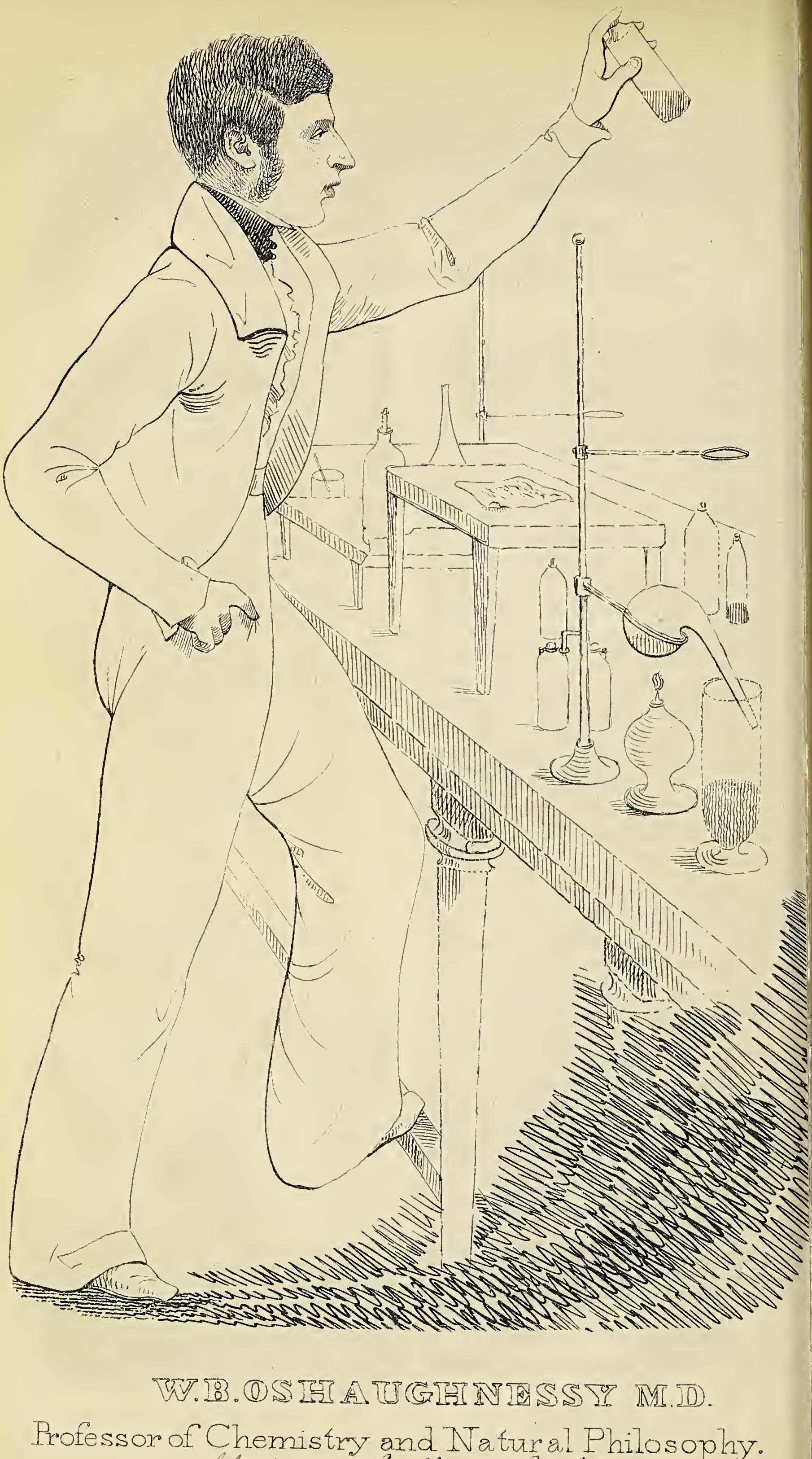
I also proposed that the stone-block or sleeper should be placed in an angular direction with the length of rail or line of road, whereby a greater surface of stone would be placed in the directions most required, viz. lengthways and sideways. By this plan an 18-inch stone exposes a surface of 2 feet and more to the pressure.

Fig. Is a section of the rail as it rests in the chair, which, when the lower portion of the chair is let into the stone, will rest upon the stone also; the two small sections are for purpose of the fixing the centre of each rail to its chair. Fig. 2 is a vertical view, showing the angular position of the stone upon a smaller scale.

I am, Sir, yours respectfully,

P. WOODHOUSE.

Kilburn, May 27th, 1835.



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T. Black Asiatic Lith Press.

No. 4, July, 1836

THE INDIA REVIEW

OF WORKS ON SCIENCE

AND

JOURNAL OF FOREIGN SCIENCE AND THE ARTS.

EMBRACING

MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS, &c.

REVIEW.

Journal of the Asiatic Society, 1835. *Analysis of a Tibetan work. By* M. ALEXANDER CSOMA DE KÖRÖS.

(*Continued from page* 81.)

Our author's view and doctrine of the natural constitution of the human body are exceedingly curious. He describes the manner of the existence of the body under four distinct heads; the first embraces the quantity of the several constituent parts of the body and the existence of those parts on which the body depends; the second refers to the state of the veins and nerves; the third regards the nature of those diseases which are pronounced as enemies to the body; and the fourth alludes to the apertures for the circulation of the air.

Thus then the quantity of wind of the body is specified, the bile, the phlegm, the blood, the urine, the serum, the chyle, and the semen have their definite proportions. The following is the author's idea of the anatomy of the human body.

"There are 23 sorts of bones; in the back-bone, 28 are distinguished. There are 24 ribs; 32 teeth; 360 pieces of bones. There are 12 large joints of limbs;—small joints, 250. There are 16 tendons or sinews, and 900 nerves or fibres; 11,000 hairs on the head; 11 millions of pores of the hair on the body. There are five vital parts (or viscera) (as the heart, lungs, liver, spleen, and the reins or kidneys); six vessels, and nine openings or holes.—In *Jumbudwipa* the measure of a man's height is one fathom or four cubits—deformed bodies have only 3½ cubits, measured by their own.

With respect to the 2nd section, showing the state of the veins. There are four kinds of veins or nerves: 1, that of conception; 2, of sensation; 3, of connexion, and 4, that of vitality.

The 1st: From the navel there arise or spread three veins or nerves, one of them ascends to the brain, and is acted on by the dull part of it, generating the phlegm in the upper part of the body. Another nerve (or vein) entering into the middle, forms the vital nerve, and depends for its existence on the vital nerve of passion and blood; that part of it, which causes bile, resides in the middle. The third nerve (or vein) descends to the privy parts and generates desire both in the male and female. That parts of it, which produces wind, resides in the lower extremity.

The 2nd: There are four kinds of the nerves of existence or sensation.

For rousing (or exciting) the organs, in their proper place, there is in the brain a principal nerve, surrounded with 500 other smaller ones. Another nerve for making clear the organ of recollection or memory, resides in the heart, surrounded with 500 other smaller ones.

That nerve, which causes the increase and renovation of the aggregate of the body, resides in the navel, surrounded with 500 other smaller ones.

That nerve, which causes the increase of children, and descendants, resides in the privy member, together with 500 other smaller ones—and comprehends or encompasses the whole body.

The 3rd: The nerve of connexion consists of two kinds, white and black. There are 24 large veins (or nerves), which, like as so many branches ascending the principal stem of the vital principle, serve for increasing the flesh and the blood. There are eight large hidden veins or nerves for making the connexions of the diseases of the viscera and vessels.

There are 16 conspicuous veins connecting the outward limbs, and 77 others spreading from them, called bleeding veins (that may occasionally be opened to let out blood.)

There are 112 hurtful or pestilential veins (or nerves); of a mixed nature, there are 189 others. Thence originate 120 in the outer, inner, and middle parts, that spread into 360

smaller ones. Thence smaller ones encompass the body as with a net-work.

There are 19 strong working nerves, which like roots, descend from the brain, the ocean of nerves; from among them there are 13 that are hidden, and connect the intestines —six others, connecting the outward parts, are visible; from them spread 16 small tendons or sinews.

There are three vital nerves (or veins) in a man. The one encompasses both the head and the body; the second, associating with respiration, moves accordingly; the third is the principal, and connecting the veins or canals, for the circulation of air and blood, is occupied with generating or increasing the body, and being the vital nerve, is called, by way of eminence, the artery or the principal vital nerve."

Judging by the foregoing analysis the author must be allowed to have been a man of considerable observation: however erroneous some of his conclusions may be; he has notwithstanding displayed great ability. Considering the dark age in which he lived and the rude inhabitants of the country among whom he dwelt, we are really surprised at the depth of his learning, There is scarcely any subject connected with medicine and surgery upon which he does not fully express his sentiments. His opinions on the process of digestion are worthy of being quoted.

"The meat and drink, after being digested in the stomach, are changed into chyle and fæces. These turn into ordure and urine, that is, for the nutrition of the body, by increasing the blood. The blood preserving the moisture or humidity of the body, keeps up life, and increases the flesh. The flesh covering and cleansing the body, both within and without, produces the fat. This makes the whole body unctuous, and causes the increase of the bone. This supports the body and increases the marrow. This improves the essential sap of the body, and produces the semen virile. This conduces to the well-being of the whole body, and to the production of a new one.

The manner in which meat and drink are changed. Whatever is eaten or drunk, is carried into the belly or stomach, by the vital air or wind; afterwards, by aid of phlegm, it comes into fermentation of a sweet taste, and increases the quantity of phlegm. Afterwards, being digested by the aid of bile, taking a hot and sour taste, it produces bile. Afterwards, by the aid of the air or wind that conveys an equal heat to the whole body, the dregs or fæces being separated, and taking a bitter taste, it generates thin wind. The fæces being changed into thick (or solid) and thin (or fluid) parts become ordure and urine.

The chyle, after having passed by nine veins from the stomach into the liver, it becomes or changes into blood; afterwards, successively, it is transformed into flesh, and the seven supports of the body.

2ndly. The hurtful things or bad humours. These are three: wind, bile, and phlegm, each with a five-fold division.

1. Of Wind. The life-keeping wind or air reside in the upper part of the head; that which operates upwards, has its place in the breast; that which pervades or encompasses all, resides in the heart; that which communicates or conveys an equal heat to the body, has its seat in the stomach; that which cleanses downwards, abides in the lower part of the trunk.

2. Of Bile. The digesting bile resides in the stomach, between the digested and indigested part; that which forms the chyle, resides in the liver; that which prepares or increases, in the heart; that which assists the sight (or causes to see), in the eye; that which gives a clear colour, resides in the skin.

3. Of Phlegm. The supporting phlegm resides in the breast; the masticatory, in the indegested part; the tasting, on the tongue; the refreshing (or that makes contented), in the head; the conjunctive or uniting, resides in every juncture (or joint).

The characteristic signs of the above-specified humours—that of wind; roughness, lightness, cold, smallness, hardness, and mobility.

That of bile; unctuousness, sharpness, lightness, foulness, depuratory moisture.

That of phlegm: unctuousness, coolness, heaviness, and dulness, softness, or gentleness, steadiness, adhesion, passionateness."

The service, rendered by the fæces, is: the ordure serves for the support of the bowels, guts, &c. By urine, morbid humours are carried off; and it serves also for a support of the thinner fæces, and carries off the putrid thick sediments.

The office of sweat is to soften the skin, and to change the obstructed pores of the hair of the body.

Fire-warmth is the common gentle warmth, or heat, of the whole body. The warmth of the stomach is the principal cause of the digestion of meat and drink of every kind. If this warmth is in good state, the digestion of meat and drink is easy; no diseases then arise, the lustre of the face, the chyle, the supports of the body and life, then increase. Therefore, the warmth of the stomach must be kept up, (or if lost, must be restored,) with every endeavour.

On dietetics our author enters with his usual systematic arrangement, not only regarding the several kinds of food and the manner of using them, but also regarding those kinds which are inimical to health, and defines what may be used together.

"For food are used, grain (or corn), flesh, butter, vegetables or greens, and dressed victuals. There are two kinds of grain: 1 growing in ears, and 2, in pods (as pulse). Flesh or animal food of eight kinds or sorts. Several kinds of unctuous or oily substances; as, butter, oil expressed from grains, kernels, fruits, berries, and trees or shurbs; grease, fat, marrow, &c. To vegetable or green things, belong potherbs, &c. To dressed victuals or meals, belong boiled rice, soup, &c. Drinkable things are milk, water, wine, &c.

17*th Chapter*.—Enumeration of several kinds of food that it were dangerous to take together; as fish and milk, &c.

18*th Chapter*.—On the proper measure of, food to be taken, or on temperance in meat and drink."

In the concluding part he gives a full description of the cure of diseases. We shall give a specimen of the author's manner of treating this part of his subject, by quoting the following, with which, we think, our brethren in Europe will be much amused.

"2. The curing of diseases arising from wind (or windy humours). There are five distinctions: 1, causes; 2, accessory cause and effect; 3, division; 4, symptoms; 5, mannər of curing (diseases arising from wind.) wind).

3. In the curing of diseases arising from (or caused by) bile, there are the following distinctions: 1, cause; 2, accessory cause and effect; 3, division; 4, symptoms; 5, manner of curing; 6, and stopping or hindering its progress.

4. In the curing of diseases caused by phlegm (or phlegmatical humours), are considered: cause, accessory cause and effect, division, symptoms and manner of curing.

5. In the curing of diseases caused by the gathering together of the three humours (wind, bile, phlegm,) and of blood, there are the following distinctions or considerations: cause, incident or accessory cause and effect, place, time, kind or genus, symptoms, manner or mode of curing, and the stopping of it for the future.

6. In the curing of indigestion, the root (or primary cause) of inward diseases, there are the following distinctions or sections: cause, incident or accessory cause and effect, manner of its arising, division, symptoms, remedy or mode of curing.

7. In the curing of a swelling (or a hard conglomoration or excrescence), there is treated of: cause, incident, division, place, manner of arising, symptom, mode of curing it.

8. The curing of white swellings, a kind of dropsy. Here are considered: cause, incident, division, symptom, mode of curing.

9. In the curing of another kind of dropsy there are the same distinctions as before.

10. The curing of dropsy is taught, by exposing the cause and incident, division, manner of arising, symptom, mode of curing, stopping or cessation.

11. In the curing of phthisis or consumption of the lungs, there are the following distinctions: cause, and accessory cause or effect, division symptom, mode of curing. And thus there are six chapters on curing inward diseases.

12. In curing feverish diseases (where heat prevails) in general, there are the following distinctions: cause incident, nature, name, symptom, mode of curing.

16. In an increased or burning fever, the same distinctions are as before, except a trifling division.

17 to 20. On curing several kinds of fever, such as are: the sly, hidden, inveterate, and the mixed ones.

21. The curing of inflammation of any hurt or wounded part of the body, with several distinctions; and that of inward and outward hurt: the inwards are, the viscera and the vessels; the outward parts are, the flesh, bone, marrow, tendon, and fibre.

22. The curing of heat or fever, (arising from the contest between wind, bile, and phlegm), in which the mental faculties are troubled, with several distinctions to be considered; and so there are 11 chapters on curing fever (heat of inflamation).

23. On curing epidemic maladies or infectious diseases, with several distinctions and divisions; as, a kind of pestilence of Nepál.

24. On curing the small-pox: cause and effect, definition of small pox, distinction, symptom, mode of curing; distinction into white and black variolæ, each having three species.

25. The curing of infectious diseases affecting the bowels (colic), with several distinction; purging the viscera and the lower vessels, affecting with greater or less vehemence; and so there are eight kinds of diseases affecting the bowels.

26. The curing of swellings in the throat (or of ulcers and inflammations), and infective diseases, as the cholera, the first has 4, the second 11, subdivisions, or minor distinctions."

"62. The curing of miscellaneous diseases of the smaller kind: such as contraction or sinking of the sinews; dysentery; any hurt caused by fire; hurt or wound made with a needle; or when a needle or the iron-point of an arrow happen to be swallowed; choaking or suffocation; or the stopping of any thing in the throat, as, a beard of corn, bone, fish-prickle; the entering or swallowing in of a spider or scorpion; intoxication; stiffness of the neck; ill smell of the body; hurt of the hands and feet caused by cold and snow; the creeping of any insect into the ear; the swelling of the teat of a woman. The curing of all such diseases is called the

cure of small diseases. Thus there are 19 chapters on minute diseases.

The healing of wounds, sores, or ulcers.

63. The curing of ulcers here are considered: cause, &c. four, with several distinctions.

64. The curing of the hemorrhoids (piles or emerods in the fundament, cause, &c. four, with six distinctions.

65. The curing of St. Anthony's fire, (any swelling full of heat and redness, cause, &c. four. with several distinctions, and the places (or parts) where generally they occur.

66. The curing of the Surya disease affecting the lungs, liver, &c. its beginning, &c. four, with some distinctions.

67. The curing of cancerous or virulent bad sores or ulcers: cause, &c. four, with eight distinctions."

"80. The curing of palsical diseases, and the telling of the periodical time of their occurence, the symptoms, and the remedies for preventing their recourse.

81. On the curing of diseases, in which the body is infested with cancerous ulcers, is eaten away and dissolved: considered cause, &c. nine, with 18 distinctions respecting its different kinds and the places (or parts) which are generally affected.

The above five chapters are on such diseases as are supposed to be caused by the influence of some malignant demon.

82. On the curing or healing, in general, of wounds, made by any kind of weapon or tool. Here into consideration come; 1, cause; 2, accessory cause or incident; 3, nature (of wound); 4, definition or description (of the wound); 5, its name; 6, place; 7, division; 8, symptom, mode of curing or remedy, excision or cutting out, cicatrizing.

83. The curing of wounds on the head, here are considered: the manner of its being; examination of the injured part, manner of curing recovering, or being overpowered.

On the practical part of medicine the following briefly exhibits the author's views.

"The examination of the pulse, wherein 13 cases are enumerated on the character of the distemper.

2. The inspection of urine, wherein, as it is said, the vicious state of the whole body may be seen, as in a mirror.

Thus two chapters are on examining the pulse and urine.

Afterwards, when the character and name of the disease has been found out, what sorts of medicaments are to be administered, is exposed.

3. First liquid medicines, of which there are 54 for curing inward heat, and 23 for assuaging cold fits or ague. Together there are 77 sorts of liquid medicine. When by these there is no remedy, further is an,

4. Enumeration of powdered medicine, or medicaments in powder, of which the mixture is stated to amount to 96, for assuaging the heat of any distemper; and 69 against cold fits. Both together =165. When they afford no relief, there is taught of another remedy.

5. Physic or medicaments in pills, of which the different kinds of mixture amount to 22.

6. The several kinds of sirup, (a kind of mixture) are described or taught; of which 15 are for assuaging heat, and five against cold fits. Both together=20.

For procuring strength to the body, and for drawing out an inveterate disease.

7. Is taught of a mixture, called medicinal butter consisting of several ingredients, of which there are 14 sorts for curing heat, and nine for taking away cold fits. Both together = 23.

8. 13 kinds of mixture of calcined powder, for curing an ague caused by a too much abundance of phlegm.

9. 17 kinds of mixture or syrup, especially for the purpose of assuaging heat.

10. 19 species of mixture of medicinal wine (or spirituous beverage), are enumerated, for curing diseases, in which wind prevails.

11. A mixture, as a remedy against any inveterate malady whatever, prepared of precious stones, for curing the diseases of princes, and of opulent men. One against heat, and 11 against cold; eight against both; together=20.

Since men, in general, cannot have precious stones required for such a mixture for curing diseases, in the

12. Is taught of such vegetables or plants that are procurable by all, of which the several mixtures amount to 24 for curing heat; and 14 for assuaging cold fit.

Thus taking together all assuaging remedies from the liquid to the vegetable medicines, there are 418. So much of the assuaging remedies. When they are insufficient in the

13. Is taught of purging or depuratory medicines in general.

14. Of purging medicines operating downwards, for carrying away corrupt blood, bile and the relics of other diseases. There are three kinds of such purging (or depuratory,) medicines, operating; gently, moderately, and strongly; of which all there are 82 species.

15. For carrying upwards or ejecting the remains of such diseases, as belong to the phlegmatical kind: here vomits are prescribed, of which there are eight of the stronger, and eight of the gentle kind, both =16.

16. A composition of medicine, for cleansing or purging the nose, five of the gentle, and two of the strong kind.

17. Elixirs or extracted juices, for drawing downwards the diseases in the entrails or intestines and guts.

18. The same continued and specied.

19. Elixirs or mixtures for cleansing the veins, (or depuratory elixirs for do.) Thus seven chapters are on depuratory medicines.

If by the above means there is no sufficient relief, in another sutra is taught of other soft and hard remedies.

20. How to let blood in such distempers, when heat prevails. There are counted 77 veins, of which any may be opened for letting out blood.

21. The application of a caustic for curing diseases, when cold, or cold fits prevail.

22. The use of a venomous mixture.

23. On the use of medical bath, for diseased members.

24. On adhibiting medicinal unguents.

25. On medicines operating downwards.

26. The conclusion. Though there be many ways (1,200) of examining the heat and cold prevailing in any disease, they all may be reduced to the following: to look on the tongue and urine, to feel the pulse, and to ask (after the circumstances of the beginning and progress of the disease in question.

Art. II.—Journal of a Tour through the island of Rambree, with a Geological Sketch of the Country, and Brief Account of the Customs, &c. of its Inhabitants. By Lieut. Wm. Foley.

In the widely extended circle of our Indian empire there yet remains so much to be gathered of general intelligence both with respect to the manners of the inhabitants and the character of the soil, that we hail with peculiar satisfaction the exertions of individuals who are endeavouring to supply us with the required information. The Government is still continuing its grand trigonometrical survey; but its progress is necessarily slow; and in the mean while we rule over large tracts possessing many intrinsic properties with which we are, and would continue to be but imperfectly acquainted, were it not for the spontaneous efforts of a few enterprising men, whom the love of science stimulates to the prosecution of such enquiry as their leisure from professional avocation permits. Our obligation is the greater, inasmuch as the motive is wholly divested of selfishness. The only wish on their part, being that their labors may be found a useful addition to our stock of general information on the points in question. Of such a character is the work before us. It is written by Lieut. Foley, and although professing to be no more than a mere "sketch" of manners and customs with an accompanying disquisition on the geology of Rambree Island, comprises a great variety of interesting and instructive matter. The narrative is well drawn up, free from all pedantry in terms, and told after a mode so wholly unaffected, that those the least initiated in "nature's mysteries" may derive gratification from the perusal.

"It was with the view ef throwing some light upon the geology of *Rambree* that I prepared this Journal for transmission to the Asiatic Society; a consciousness of my present superficial information on many points connected with the geology of the island would have induced me to reserve this communication for a more favourable opportunity was I not apprehensive that such a season would never arrive, and that the little leisure I now have at my disposal must of necessity be devoted to duties of a professional nature. To a brief geological description of the island I have aded such other matter connected with the condition, and manners of the inhabitants as appeared deserving of mention, either from its novelty, or the value it may possess in the scale of utility."

Lieut. Foley commences his journey at Khyak Phyoo, the military cantonment of our Government on the Island, and skirting along the coast conducts us to the principal town of *Rambree.*

In the year 1148, (Mugh series) the conquest of Arracan was effected by the Burmese, who divided the country into four principal districts, naming them Dwyanawaddee, (or Arracan Proper.) Yamawaddi (Rambree Island) Megawaddie, (Cheduba) and Dornawaddi (Sandoway). Lieut. Foley supposes Cheduba to be a name given by the Bengalís, as the proper native name is Máong.

The Island of Rambree presents along the coast, high land, covered for the most part with impenetrable jungle; it is only in the interior that spots have been cleared out for cultivation. The geology of the island affords nothing very novel. The rocks are of the newest formation and owe their origin to the agency of fire. Alluvial and diluvial deposits are common to the whole tract. The Hills range from N. N. E. to S. S. E. and vary in their elevation from 500 to 3,000 feet. Smaller hills, branching from

them form "basin-like cavities" which give room for the cultivation of rice. The soil of the hills is argillaceous, and their surface being thus composed of a stratum of clay, the deposit at their base being formed of the same, affords opportunities for cultivation contrasting strongly with that in the immediate vicinity of the cantonment.

Leaving Khyak Phyoo our traveller proceeds by the sea-shore towards the villages of Membrann and Kyaprath ; in the neighbourhood of the former he finds some old Petroleum wells, which are no longer worked. He then reaches Kyakprath, where the hills have been partially cleared and small patches of open ground are devoted to the growth of cotton. While at this last place our author had an opportunity of witnessing some of the games to which the inhabitants are much addicted. These are boxing, wrestling, and the *kulome*, described as something similar to our "battledore and shuttlecock ;" only that the ball which is hollow and made of cane," is impelled by the foot instead of the hand. In addition to these the Mughs have other peculiar festivals of which the principal are,

SANGRAIN-KYADEH.*

This occurs in the month of *Tagoo-la*, (April, at the commencement of the new year, and during this season, the games of *Reh-loun-dee*, and *Léh-prinedee* are held. The former very much resembles what is observed in our own country on New-year's-day. The women throw water over the men, who generally return the compliment ; no distinction is paid to rank. The water is thrown indiscriminately, and with an unsparing hand, upon high and low, and all seem determined to enjoy a season that permits of such unlimited freedom. The *Léh-prinedee* is the boat-race, which is held at the same time : a number of boats assemble in a broad creek, and start for a certain place, each striving to outstrip the other. The boats are impelled with oars, and those that are light and well manned, have a surprising speed upon the water. The shouts of the rowers, the strains of wild music, and the gay appearance of the boats decked out at the stem with branches of plantain trees and garlands of flowers, give a most pleasing and striking effect to the scene. Returned to the place from whence they started, a donation in money, or a piece of silk, is generally presented to the winner by the master of the ceremonies. Nautches and entertainments succeed the boat race, and the festivities are closed with offerings to the priests and the *Rautoo**, who is on this occasion carefully washed and adorned.

2. OOBHO-CHOUNDE.—This festival is held in the months *Wajho*, (July,) *Wagoung*, (August,) *Tantha-leng*, (September,) and *Sadyne-Kyot*, (October.) The people fast for a few days in each month, and proceeding to the Kioums†, dressed in their smartest attire, prostrate themselves before the Phraa‡, and make suitable offerings to the priests.

3. WINGBAUH-POE.—occurs in the month *Sadyne-Kyot*. (October.)—By way of celebrating this festival, a labyrinth is constructed by means of bamboo fences, so placed, as to make the path very narrow and intricate from the numerous turns it takes.

People of both sexes, and of all ages, flock to this place in the evening, dressed in their smartest clothes, ; old as well as young thread the labyrinth, enjoying the fun that is occasioned by their several mistakes in endeavouring to get out of it. A temple is erected in the centre of the labyrinth, and within it are four images of the Ruddha saint, to which the passengers severally make obeisance, placing small lamps upon different parts of the building for the purpose of illumination. The evening of each day generally closes with a display of fire-workes, and the *Bouthséy*, a ludicrous dramatic representation, very much resembling the *Putlé* of India. In addition to the above, a ceremony, termed the *Puddéy-sah*, is performed during the month of *Sadyne-Kyot*. This consists in the construction of a frame-work, intended to present a tree which is carried about upon the shoulders of the people, and upon it are hung such bequests as are made by individuals, in the shape of cloth, silks, dishes, &c. the whole of which are intended for the use of the inmates of the *Kioums*. Much is collected in this manner, it being considered highly meritorious to make even the smallest gift on this occasion. The procession is generally accompained by dancers and musicians, whose services are wholly gratuitous ; for whatever they may indivially collect, is, in like manner, devoted to the necessities of the *Kioum*.

4. The *Ruttah-bôeh* is held in the month of *Taboo-dwar*, (February,) when the cold weather is supposed to have ended. A small tree is placed upon a car that had been constructed for the purpose, and to each end of this vehicle ropes are attached. The people assemble at the place from all quarters, and two parties (generally selected from the inhabitants of two neighbouring villages) are

* The whole of these festivals owe their source to some fabulous narrative, preserved in the sacred writings or other books, and religiously believed by an ignorant and superstitious people. I regret that I am, from my very imperfect acquaintance with the language of this country, debarred an opportunity of transcribing any part of these.

* Image of Gautama.
† Monasteries.
‡ Gautama.

formed for a trial of strength : one party pulling against the other. The successful party is allowed to draw the car away to their own village, where it is finally consumed.

Several other wrestling matches were made until it became too dark to prolong the game. I now returned to the village, and entering my host's house found a supper waiting my arrival. It was laughable to observe the curiosity of the villagers to see an *Ingllee* at *the feeding hour.* Men, women, and children mounted the *michaun*, to the very great hazard of its coming down. There was in the appearance of my visitors nothing of that fear and abject submission so characteristic of the natives of India. The women, as well as the men, stood gazing upon me, and all joined in the laugh excited by the European mode of handing the food to my mouth ; to them so incomprehensible and ridiculous. The children were not afraid to approach, and I was not so uncivil as to refuse them a share of the viands they apparently coveted. It was received with pleasure, and offered in return to their parents. A mother had a very pretty infant at her breast, and I was surprised to see her give it a piece of bread that had been previously chewed. I found on inquiry that a child is fed with a mouthful of boiled rice, reduced to a state of mucilage, on the second day of its birth. This it is said conduces to its vigour, and hastens the period for its final separation from the breast.

The next stage is *Kaeng* which is remarkable as exhibiting the remains of a few mud volcanoes, the only indication of their activity however being the existence of a spring of muddy water at the summit of each volcano. "The mud was of a grey colour and impregnated with much calcareous matter." Other volcanoes or their remains were visible on the hills to the left as our journalist approached *Kaeng*. From the undulating appearance of these, covered with a fine green sward, and studded with a few Jhow trees (as is invariable where ever these volcanoes are found) the effect is said to be both agreeable and striking. At the foot of a volcano Lieut. Foley found several "boulders" of a rock resembling *clinkstone*, which he imagines to have been ejected from them while in a state of igneous fusion. From *Kaeng* the route continues to *Sadong*. This is one of the most fertile districts of the Island. Extensive plains of rice cultivation and petroleum wells yielding "a fair supply of oil are found here, and such is the fruitfulness of the soil that the principal exportations of the former are from this place. One well is said to give as much as three quart bottles of oil daily and "allowing that the others afford as much, the entire quantity would be 70 maunds, between the 1st of November, and the 1st of June. These wells, and indeed all those existing in this Island, and that of *Cheduba* are farmed by Government, and sold to the highest bidder. The system is regarded as a bad one, and in lieu of it Lieut. Foley proposes as follows.

"The whole of the wells known to exist in the islands of Rambree and Cheduba are farmed by Government, and sold annually to the highest bidder ; I conceive it would be (in the end) far more advantageous to Government was the sale to take place *every three years*, instead of *annually :* was more labour bestowed upon these wells, the produce would be greater ; but the present system deters a purchaser from devoting his labour to the production of an article that may become the property of a more successful candidate, before he shall have received any return for the capital he had already invested in them. The wells were sold this year for 120 rupees.

The oil is sold in *Ladong* at the rate of one-half tillia per rupee. The weight of a *tillia* varies from nine to sixteen seers. The *Ladong tillia* of oil is said to be as much as can be contained in 18 bottles or 13½ seers. The oil is much used, especially for burning ; it burns long, and gives a fine clear flame ; it has, however, a very disagreeable smell, and is so highly inflammable, that it must be used with caution.

The oil produced on the Island of *Cheduba* is not so abundant or so pure as that of *Rambree.* One of the Petroleum wells in *Ladong* is said to exist on the site of a dormant mud volcano—a circumstance not at all improbable, when it is considered, that the gasess and inflammable substances forming the constituent parts of either, are, as far as has been hitherto discovered, essentially alike. The soil thrown up from these wells is highly bituminous, and in some instances abounds with very beautiful crystals of iron pyrites."

Whilst at *Ladong* our author witnessed the funeral rites performed over the body of a Phoongee or Buddhist priest, and takes the opportunity of making minute enquiry as to the nature of their religious duties.

"The assumption of the monastic garb is voluntary ; the person who expresses a wish to become a *Phoongree* is admitted into the convent (without regard to country, or the religion he may formerly have professed), provided he stipulates his readiness to con-

form to the Buddhist observances in matters of faith and discipline, and there exists no impediment (such as his having a family to support, or his not having obtained the permission of his parents, &c.), to his abandonment of earthly pursuits ; sickness, deformity, and a bad character are also sufficient causes for rejection. Should none of these obstacles present themselves, the candidate is admitted into the *Kioum*, and attired, in the prescribed dress, enters upon the duties of a *Phoongree*. If, as is generally the case, his age shall not have exceeded 15 years, he is appointed to the performance of the menial duties, and gradually initiated in the peculiar tenets of the sect, until he shall have arrived at the age of 20 years, the time appointed for confirmation."

It is remarkable how most religions (we altogether except the Mahommedan, which commenced by enforcing its doctrines at the sword's point, start with a purity from which the disciples but too frequently diverge. Many are the proofs that originally there was but one Law Giver and but one law acknowledged. In all creeds we are taught that abandonment of worldly objects is the first and most momentous exaction, but as society advances, we almost invariably find the priesthood claiming their privileges in secular affairs, and entering with avidity into the schemes, intrigues, and politics of the Governments to which they belong. It is evident that religion should remain all together removed from scenes of contention ; because it is in its essence immeasurably superior to them. Such, however, is the common frailty of our nature that we cannot divest ourselves of individual claims in society nor set ourselves wholly apart for the service of God without forfeiting those worldly advantages, which it is one of the weaknesses of our lot to be thus unwilling to forego. How long the people whose manners and customs we are tracing will retain their present habits, is hardly problematical. Simple as they appear, their customs are indescribably immoral ; and characterized with a degree of shamelessness which steel their hearts against those noble and warm endearing affections which civilization, perfected by the doctrines of unsullied Christianity, inspires. Our intercourse, if enlightened with such views, will assuredly engender other thoughts and offer other prospects, when the period arrives which will fit them for a simpler and holier creed. On the other hand, if the intercourse of Europeans with them be unsanctified by any religious feeling, how much of evil passions now dormant will not be awakened, how much of primitive simplicity will be exchanged for the cunning of the world's knowledge and craft among these pupils of Boodha. We shall follow up this review in our next No. and offer to our readers some general remarks on the necessity of pursuing this species of investigation with a more determined vigor. The advantage would be to the Government as the power to perform it certainly is. Will it be exerted ?

TIEDEMAN'S PHYSIOLOGY OF MAN.

PARALLEL BETWEEN THE MANIFESTATIONS OF ACTIVITY OF ORGANIC AND THOSE OF INORGANIC BODIES.

(*Continued from page* 86.)

OF THE MENIFESTATIONS OF ACTIVITY COMMON TO ORGANIC AND INORGANIC BODIES, AND THEIR MODIFICATIONS IN THE FORMER.

XLVIII. The manifestations of activity and of power of inorganic bodies are reducible to repulsion and attraction. The first is shown by impenetrability and extension, the second by mechanical attraction, gravity, cohesion, adhesion, and chemical affinity. Physical philosophers designate by the names of attraction and repulsion those inherent causes in bodies on which these phenomena depend. They have discovered a great portion of the laws according to which these forces act, without being able to detect their fundamental cause.

XLIX. Similar phenomena, or manifestations of activity, are observed in living bodies. All of them possess extent and weight ; cohesion and adhesion is exerted in all of them, and we see besides, in all, the play of chemical affinities. But these phenomena, although the effects of general physical forces, are modified by the manifestations of activity peculiar to organic bodies, called life, and by powers of a particular kind, viz. organic powers. All the physical and chemical properties of plants and animals, the manner in which they fill space, their extension, their gravity, their cohesion, the chemical affinities which operate in them, depend more or less on the organic powers by which they are animated. A further proof of this is, that plants and animals are

produced from other living bodies of the same species as themselves, and that all their qualities, form, peculiarities of weight, of adhesion and cohesion, the form and composition of their parts, in short the mode of showing their own action, are determined by the organic powers of the bodies which originate them. We know of no living body generated by the action of purely physical or chemical forces. All the qualities, therefore, of organic bodies should be looked upon as the effects of life. Even those phenomena seen in them, which they exhibit in common with organic bodies, undergo modifications of their specific action, and should be considered as subordinate to the organic powers.

L. The weight of different living bodies depends on their life, and varies according to the periods of age, the state of nutrive functions, and divers influences, external as well as internal, which modify the manifestations of activity of these functions. The specific gravity of all their solids and liquids is also subject to continual changes during the course of their existence. The liquids contained in the different spaces, cavities, or vessels of the plants and animals, are not distributed according to the law of gravitation alone: they are frequently moved against their gravity, and their manner of movement and of distribution is dependent on their manifestation of life.

LI. The degree of cohesion, of adhesion, and consistence of organic bodies, of all their liquid and solid parts, varies extremely according to the duration of their existence and manifestations of activity. Plants and animals have but little consistence and cohesion in the first period of their existence. These properties become more pronounced in them in proportion as they are developed, and for the most part they attain their maximum in advanced age. Various influences, which modify their manifestations of life, as heat, light, the atmosphere, water, and food, produce changes in their state of cohesion. This changes even in consequence of their internal action, as is particularly seen in the contraction of the muscles. The same is the case with the chemical affinities met with in living bodies. The composition of these bodies, as well in their entire as in their different parts, together with all the changes which take place during the existence of organic bodies, should be considered as the effects of life.*

Neither does heat spread over living bodies in the same manner, nor after the same laws, as in bodies not endued with life. The greater number of animals maintain the temperature peculiar to them, although that of the surrounding media be different.

LII. Even when the life of organic bodies is extinct, we should consider the qualities which they possess, from the time of death to the complete resolution of organization, as results of the organic powers which have been active in them. Besides the powers of life, Bichat* admits, in organic bodies, particular qualities, amongst which he classed extensibility, contractility, and elasticity of the tissues, which he regarded as inherent in their texture and the arrangement of the molecules of which they are composed. He thinks them independent of life, because they remain after death, and are only annihilated after the establishment of putrefaction and destruction of the organs. He adds, that life certainly augments their energy, but that it is not the cause of it. These properties are also the effects of forces which life has put into action, for the tissues which possess them have been produced during life and by life. The qualities which still remain inherent in them after death proceed from their composition and texture, and these are produced by the manifestations of life. So soon as chemical affinities take the upper hand in dead bodies, during fermentation and putrefaction, these properties of the tissues also disappear and are destroyed as the last remaining effects of life.

LIII. Hence it follows that the qualities of organic bodies, as well those observed in life as those remaining even after death, should be considered as the effects and results of special powers that are exercised in these alone. All the phenomena of these bodies, even those of general physical forces, are produced or modified by life and its powers. Reil, therefore,† was right when he said that, in a living organ, nothing is dead, not even elasticity, and that all therein is modified by what we call life.

The manifestations of life, such as we recognize them, are inexplicable by the general laws of physics.‡ Neither the power of

* Berzelius also (Lehrbuch der Chemie, v. 3, part 1st, p. 135) recognises this, when he says, "The elements seem to obey, in living bodies, other laws than those in dead bodies, or bodies not endued with life. The cause of this difference has hitherto been withheld from our enquiries, and we attribute it to a power of a peculiar nature, belonging only to living bodies—the vital power. This something is placed altogether beyond inorganic elements; it is not one of their original qualities, as gravity, impenetrability, electric polarity, &c.; but we can neither conceive what it is, nor how it is generated or finishes."

* On Life and Death, p. 43. General Anatomy, v. i, part 1, p. 35.

† Archiv. für die Physiologie, v. vii, p. 438.

‡ Buffon (Histoire Nat., v. ii, p. 50) says, "J'avoue que je pense bien differemment de ces philosophes; il me semble qu'en n'admettent qu'un certain nombre des principes mechaniques, il n'ont pas senti combien ils retrécissoient la philosophie, et ils n'ont pas vu, que pour un phenomene qu'on pourraity rappeler, il y en avoit mille qui en etoient independens. L'idee de ramener l'explication de tous les phenomenes a des principes mechaniques, est assurement grande et belle: ce pas est le plus hardi qu'on put faire en philosophie, et c'est Descartes qui l'a fait; mais cette idee n'est qu'un projet. Le defaut de la philosophie d' Aristote etoit d'employer comme causes tous les effets particuliers; celui de celle de Descartes est de ne vouloir employer comme causes, qu'un petit nombre d'effets generaux, en donnant l'exclusion à tout le reste. Il me semble que la philosophie sans defaut seroit celle où l'on n'employeroit pour causes que des effets generaux, mais où l'on cherheroit en meme temps à en augmenter le nombre, en tâchant de generaliser les effets particuliers."

repulsion, nor that of attraction, with all their modifications, is sufficient, according to researches hitherto made, to explain life. Already it has been more than once attempted to deduce life from the laws of mechanics, physics, and of chemistry. This error has been committed by the physiologists and physicians of the iatromathematic and iatrochemical schools. In every age distinguished naturalists discovered this error and opposed it. The difficulty of explaining the manifestations of activity of living bodies by the laws of other natural powers, probably depends on the imperfect knowledge which is possessed concerning natural phenomena in general; but so long as we cannot succeed in accounting for them in this manner, we are authorized in attributing them provisionally to powers of a particular species.

(To be continued.)

ON THE RELATION OF THE SPECIFIC HEAT OF BODIES TO THEIR ATOMIC WEIGHTS.

This paper is intended to convey a condensed view of the researches of Avogrado, an Italian philospher, as related in two separate memoirs.*

It may be proper to observe that in a previous paper,† from the consideration of the affinity between the density and specific heat of bodies, he had established the formula $d=\frac{m}{a3}$ where the density of the ductile metals, is simply proportional to the mass of the atom divided by the cube of its affinity for heat, or affinitary number as it may be termed; a represents the quantity which corresponds with the cube of the distance of the centres of the atoms, that is to say, this distance is simply proportional to the affinity of each substance for heat, the mass of the atom not entering into its determination.

The affinitary number is obtained by dividing the atomic weight of a body by that of potassium, which is considered unity: thus, the affinitary number of gold will be $\frac{2\cdot5}{15}=2\cdot5$. or, as Avogrado makes, $\frac{24\cdot86}{4\cdot9}=5\cdot073$. Then $m=5\cdot073$, $d=22\cdot18$ and $d=\frac{m}{a^3}$ or $a=\sqrt[3]{\frac{m}{d}}$ gives $a=\sqrt[3]{\frac{m}{a}\;\frac{5\cdot073}{22\cdot18}}=\cdot6115$, the affinity of gold for heat.

M. Avogrado, by his experiments on the specific heat of bodies, has confirmed the accuracy of the law deduced by Dulong and Petit, from their researches, *that the specific heat of the atom of a compound gas is expressed by the square root of the whole, or fractional number of the atoms of the simple gases, by whose combination the compound atom is formed.* He has, however, been more particular in his expression of the law, which, according to him, is of the following import: *the specific heat of an atom of a compound body is equal to the square root of the whole, or fractional number, expressing the atoms or portions of atoms which, by their combination, from the atom of the compound body, whether in the solid or liquid state, adopting as unity the specific heat of some simple body in the same state.* This rule, however, is not easily applied to solids and liquids, because the atoms and volumes of gases are equivalent; whereas, in the former classes, it is a question requiring much investigation to resolve, what is the composition of the compound atom in the solid or liquid state. For the composition, according to theoretical considerations, is often different from what it is in the gaseous or vaporific state. Impressed with a desire of clearing up this difficulty, Avogrado was led into the discussion of the subject of the atomic weight of bodies, and has considered it proper to reduce the numbers attached to them by the Continental chemists to one-half. These new numbers being deduced from the consideration of the specific heat, he has termed them *thermic atoms.* The numbers were ascertained by means of an instrument of simple construction. The vessel in which the substance to be experimented on was placed, consisted of a cylinder of thin brass, with a flat upper edge. To this is applied a brass plate, pierced with three holes in its circumference, to enable three screws to pass which rise on the edge of the vessel, and are tightened from above by nuts, so that by interposing between the plate and the edge of the vessel a portion of oil skin, the access of water and external air is completely prevented. This vessel is contained in a large one, also made of brass, intended to hold a determinate quantity of water at the temperature of the atmosphere, in which is placed a small mercurial thermometer with a brass scale, and covered bulb, which is completely immersed in water.

To ascertain the specific heat, the small vessel was filled with the substance in powder, if it was a solid, and the weight noted. The vessel was then closed with the brass plate, and was kept in a vessel full of boiling water, until it was concluded that it, as well as its contents, had acquired all the heat which could be communicated to it by boiling water. The temperature of the air; that of the water contained in the interior vessel of the apparatus, and that indicated by the thermometer which was plunged into it were marked; the small vessel was then rapidly removed from the vessel of boiling water, by means of a pair of pincers, and placed in the exterior vessel. This being done, the temperature indicated by the thermometer of this vessel was marked every minute. This temperature increased at first rapidly, then slowly, and generally reached its maximum in eight or ten minutes. It is obvious that this method would be a very easy one for determining the specific heat of bodies, if it did not

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* Ann. de Chim. et de Physique, t. lv. and lvii.

† Memorie della Reale Accademia delle Scienze di Torino, xxx. 91.

happen that during the experiment, the water in the exterior vessel is constantly giving off heat at the expense of the substance, which is the object of experiment, and conveying it to the vessel and surrounding bodies. Avogrado, however, corrected this source of error by applying Newton's law, according to which, the communication of heat is continually proportional to the actual difference to temperature between the two bodies, a law which is exact for moderate temperatures. He found also a formula nearly accurate, in which the excess of temperature of the exterior vessel, and of the water contained in it, above that of the surrounding air, as well as of the interior vessel, and the substance contained in it above that of the water, is regarded as being a mean during the experiment between the initial and final excess.

According to the law of Dulong and Petit, the specific heat of simple bodies, taking for unity that of an equal weight of water, multiplied by their atomic weights, gives us the constant number ·375, (or ·376*) In other words, the specific heat of an atom of these bodies is ·375, adopting as unity the specific heat of a body of water, equal in weight to that of an atom of oxygen. From which it follows that if the same law applies to oxygen, and if the relation adopted between the atoms of different bodies and that of oxygen, is really that which exists between the atoms, to which the law refers, and which may be called their *thermic atoms*, the specific heat of oxygen in the solid state, ought to be 0·375, taking as unity that of an equal weight of water. This, however, cannot be verified by experiment, because we are unacquainted with any method of operating upon oxygen in the solid state. It is obvious, therefore, that to fix the atoms of bodies relative to oxygen, is somewhat arbitrary; for the rule of the equality of the specific heat of atoms, would be verified by doubling all the atoms in relation to that of oxygen, or in taking a half or third, provided that we changed at the same time the constant number.

Let us turn our attention to various bodies with this object in view. I. The specific heat of carbon appears to indicate that we may, reduce the atoms of sulphur, and the metals to one-half of the numbers attributed to them at present. The atom of carbon is really 0·764 (or rather ·75, as will be presently seen) of the atom of oxygen. The same relation ought then to subsist between the atoms of carbon and oxygen, both in the solid state, in order that the law of Dulong and Petit may be applicable. The specific heat of carbon, according to the determination of Crawdford and Avogrado, is ·25, or one fourth of that of water. Now, ·75, the true atom of carbon (and not ·764, the number adopted on the Continent) $+$ .25 $=$ ·1875, or the half of ·376, and exactly the half of .375, the co-efficient adopted by Avogrado. From this fact Avogrado argues that the co-efficient of the law of Dulong and Petit ought to be reduced to this half number, .1875, and for the same reason that the atoms of sulphur and the metals should be reduced to the half of the numbers which represent them at present. The specific heat of carbon would then be, according to this modified law $\frac{0\cdot1875}{0\cdot75} = 0\cdot25$, or exactly the result of experiment. The number deduced by Avagrado is, however, incorrect, because he adopts ·764 as the atomic weight of carbon, instead of ·75, the number obtained by Dr. Thomson, and which is here substituted.

In this view of the subject the specific heat of oxygen, in the solid state, ought to be ·1875, a number which Avogrado also finds to be nearly the specific heat of oxygen in the state of gas, by a calculation founded on the experiments of Berard and Delaroche, relating to the specific heat of the oxygen of the air compared to that of water; and it is probable that the specific heat of a body, which preserves the same atomic composition may not differ much in each state. This could not happen, however, if the numbers are preserved to which Dulong and Petit applied their law, because the specific heat of oxygen would then be ·375, or the double of that which it possesses in the gaseous state.

2. PHOSPHORUS.—The specific heat of this substance was determined by Avogrado, by observing how many degrees, phosphorus at several degrees below zero cooled the liquid (which was spirit of wine) in the exterior vessel. The mean of two experiments gave for the specific heat of phosphorus 0 385, taking that of water as unity. Now, that atomic weight of phosphorus being 2· we obtain an approximation to this number if we take the fourth of it, or ·5, and divide the co-efficient ·1875 by it. The quotient is ·375, or the specific heat of phosphorus in the solid state. Hence, according to the view laid down by Avogrado, the thermic atom of phosphorus will be ·5. In the gaseous atom he considers that there would be 8 thermic atoms.

3. ARSENIC.—The atom of this substance is 4·75, the half of which is 2·375. To obtain the specific heat we have $\frac{\cdot1875}{2\cdot375} =$ ·79 or ·80. The number obtained by the experiment was ·81. Mitscherlich has found the density of the vapour of arsenic correspond to double the number at present received as the atom of arsenic. There would, therefore, be in the gaseous atom four thermic atoms.

4. IODINE.—For the specific heat of this substance in the solid state, Avogrado obtained the number ·089.

Now, to procure an approximation to this number theoretically, we must divide the atom 15·75 by ·8, and we have 1·967. Now, $\frac{\cdot1875}{1\cdot967}$ $=$ ·095. Hence arsenic is analogous to phosphorus.

We may, perhaps, extend the same analogies to bromine, and chlorine. Avogrado infers that the combining atom of azote is formed of 2 thermic atoms; those of chlorine, iodine, bromine and phosphorus, of 8 thermic atoms, and that of arsenic of 4 true or thermic atom, each multiple atom requiring 5 atoms of oxygen to form nitric, chloric, iodic, bromic, phosphoric, and arsenic acids.

Now, with regard to compound bodies, Avogrado considers that the law deduced from

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* Thomson on Heat and Electricity, 97.

the experiments of Dulong or the specific heat of compound gases applies equally to the specific heat of compound bodies in the solid state, viz. that the specific heat of the compound atom of a solid body, taking as unity that of a simple atom, given by the law of Dulong and Petit, is represented by the square root of the whole or fractional number, which expresses the atoms or portions of simple atoms of different kinds, entering into the formation of this compound, a number, which, for brevity's sake, may be termed the *constituent number* of the compound atom. Consequently, to obtain the constant number, ·1875, it is necessary to multiply the specific heat of compound bodies (taking that of an equal weight of water as unity) first by the weight of the compound atom, taking that of oxygen as unity, as for simple bodies, and to divide by the square root of the constituent number; and reciprocally to obtain the specific heat of a solid body, taking as unity that of an equal weight of water, we must multiply the square root of the constituent number by ·1875, and divide by the weight of the compound atom. It will now be proper to consider the application of this law to the different kinds of compound bodies.

EXAMINATION OF HAIR SALT, OR NATIVE SULPHATE OF ALUMINA AND IRON.

By Robert D. Thomson, M.D.

The salt known under the name of hair salt and feather alum, which is produced by the decomposition of strata containing iron pyrites, has been examined by different chemists; but hitherto no definite composition has been assigned to it, notwithstanding the length of time which has elapsed since it was first noticed.

Dioscorides presents us with a detail of its characters so striking as to prevent any mistake in identifying it.* He describes it as being very white, astringent, in capillary portions, which resemble what was called in Egypt *trichitis*. Pliny likewise mentions it particularly: "Concreti," says he, "aluminis unum genus schiston appellant Graeci, in capillamenta quædam canescentia dehiscens. Undequidem trichitin potius appellaver. Hoc fit e lapide ex quo et chalcitin vocant," &c.†

The indefatigable Tournefort visited the island of Milo, from which the salt described by these ancient authors was derived, and has satisfied us that the characters, as given by Dioscorides and Pliny, are quite accurate.‡

I. Klaproth examined a salt of a greyish-white colour becoming yellow by exposure to the air, occurring in alum state, and found its chemical composition to be Alumina 15·25, Protoxide of iron 7·50, Potash ·25, Sulphuric acid and water 77, total 100·§

If we consider the alumina and iron to be saturated the constituents will be, Alumina 15·25 7, Protoxide of iron 7·5 1. Sulphuric acid 41·77 8, Water 35·48 31, total 100·00* equivalent to 7 Al. S. + *f* S. + 31. Aq.

2. The same chemits states that the hair salt from the mercurial mines of Idria, (Halotrichum Scopolii), found in alum slate, possesses a silvery white colour, and consists essentially of sulphate of magnesia, united with a small portion of sulphate of iron. According to a recent analysis hair salt from Idria consists of

Magnesia........	16·389	- 1 atom.
Protoxide of iron..	0·226	-
Sulphuric acid....	32·303	- 1 ,,
Water	50·934	- 7 atoms
	99·852†	

which answers to MS. + 7 Aq. mixed with a little sulphate of iron, agreeing exactly in composition with the right prismatic crystals of the common Epsom salt. A similar mineral from Calataynd, in Arragon, yielded, Magnesia 16·495, Sulphuric acid 31·899, Water 51·202, 99·596

3. Berthier has published the analysis of a hair salt, (Thomson's Inorganic Chemistry, ii. 768.) consisting of Sulphurie acid 34·4, Protoxide of iron 12· Alumina 8·8, Magnesia 0·8 Water 44· 100· corresponding with $\frac{1}{2}$ Al. S. + *f*S. + 15 Aq.‡

4 In the course of an excursion to the eastern parts of the colony of the Cape of Good Hope, H. Hertzog discovered two hair salts in a cave on the Bushman River, 200 feet above its bed, in 30° 30′ S.L. and 26° 40′ E.L., twenty miles from the sea. The cave was thirty feet wide, seven feet high, and twenty deep, having its upper part coated with feather alum, presenting the appearance of gypsum. The salt is snow-white, fibrous, with a silky lustre, the darker coloured fibres being very elastic. The fibresare partly straight and partly bent. The mineral consists, according to H. Stromeyer, of Alumina 11·515, Magnesia 3·690, Protoxide of manganese 2·167, Sulphuric acid 36·770, Water 45·739, Chloride of potassium 0.205, 100·086§ which is cxpressed by

$2\frac{1}{2}$ Al. S. + ($\frac{3}{4}$ M. + $\frac{1}{4}$ *mn.*) S. + $20\frac{1}{3}$ Aq.

Under the alum a bitter salt is found, which is frequently crystallized in four-sided prisms, and when pure, is white. The mass accompanying the bitter salt is weather-beatcn, earthy, and has a salty appearance, and a grecnish-white colour. It contains scales of mica, or talc, which are parallel with its cleavage. H. Stromeyer found it to contain silica and alumina in considerable quantity; very little iron, much mangancse, and one per cent. lime and magnesia. Water extracts from it common salt, gypsum, bitter salt, sulphate of manganese, and a trace of sulphate af alumina.

The salt itself consists of Magnesia 14·579, Protoxide of manganese 3·616, Sulphuric acid 32·258, Water 49·243, 99·696, corresponding with 11 MS. + *mn* S. + 91 Aq.

(To be Continued)

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* V. 323,
† Plin Nat. Hist. xxxv. 15.
‡ Tournefort's Voage 177.
§ Beitrage, iii. 103, Chemische Untersuchung des federalauns von Freyenwalde.

* Beitrage, iii. 104.
† Poggendorff, Annalen, xxxi. 144.
‡ Ann. des Mines, v. 259.
§ Poggendorff, Ann. xxxi. 142.

CHEMICAL ANALYSIS OF GADOLINITE, TOGETHER WITH AN EXAMINATION OF SOME OF THE SALT OF YTTRIA AND CERIUM.

BY THOMAS THOMSON, M.D., F.R.S., L. AND E., &c.,
Regius Professor of Chemistry in the University of Glasgow ; and ANDREW STEEL, *M.D.*

The specimen of *gadolinite* which furnished materials for the experiments contained in this paper, was purchased several years ago from a German mineral dealer. He stated that he had accidentally observed it in a collection of minerals in Sweden, from the proprietor of which he procured it, and that its orignal locality was not certainly known. It weighed several ounces.

It was an amorphous mass, having a very deep green colour, so as to appear to the eye almost black.

The lustre on the fresh fracture was vitreous and splendent. But when broken in certain directions it presented a surface almost dull, having a whitish aspect; but when viewed ed through a microscope no extraneous matter could be observed. The colour and want of lustre was probably owing to long exposure to the air, which had acted through certain natural rents in mineral. For it broke with much more facility, so as to exhibit the dull than the splendent surface.

Hardness 6·5 ; specific gravity at 60° from 4·1493 to 4·1795. The mean was 4·1607.

Its other characters being the same as those of common gadolinite need not be described here. Twenty grains, by ignition, acquired a brownish colour, and lost 0·198 grains of weight, or almost one per cent. This loss was doubtless owing to the escape of water.

During the pounding of the mineral for analysis small metallic looking grains were observed, which were carefully picked out and submitted to the following examinations. They were malleable, infusible before the blowpipe, not acted on by muriatic acid, but dissolving slowly in aqua regia. The solution had a deep orange colour, a few blackish grains remaining at the bottom. It afforded a yellow precipitate with sal ammoniac and salts of potash and was obviously platinum. From 120 grs. of the mineral 2·33 grs. of platinum were picked out. But the quantity was found to vary in different pieces.

We attempted to analyze gadolinite by the processes employed by Berzelius. But we found that the peroxide of iron, which we had precipitated by benzoate of ammonia, contained also glucina, from which we could not separate it by means of benzoate of ammonia, however carefully added. This led us to a careful investigation of the properties of cerium, yttria, and glucina. The facts ascertained suggested the following method of analyzing gadolinite :—

A. 25 grs. of the mineral, finely pounded, were boiled in a flash with aqa regia, till the whole was decomposed. The gelatinous silica remaining, collected on a filter, and well washed, weighed, after ignition, 6·22 grs.

B. The residual liquid was evaporated to dryness, and the solid matter remaining, digested for some time in distilled water. A solution of oxalic acid was then added as long as it occasioned a precipitate, and until this precipitate was of a perfectly white colour. The oxalic acid retained in the solution the iron, glucina, &c., and threw down the yttria and cerium in the state of oxalates. The whole was thrown upon a filter, and the white insoluble matter was well washed. When dry it was a beautiful light, snow-white powder, and weighed, after ignition, 12·617 grs. It had now assumed a light yellow colour and was a mixture of oxide of cerium and yttria.

Various methods of separating these two substances from each other were tried, but without success, on account of the perfect correspondence of the two in all their properties. We were, therefore, obliged to have recourse to the common method of putting a quantity of solid sulphate of potash into a neutral solution of the yttria and oxide of cerium, which threw down the cerium and left yttria. But as the quatities were never absolutely the same in two successive experiments, this method is certainly suspicious. By this method the 12·176 grs. were resolved into

Yttria	11·087
Peroxide of cerium.....	1·530=143protoxide.
	12·617

C. The oxalic solution from (B.) was evaporated to dryness, and ignited to destroy the oxalic acid. The residue was dissolved in muriatic acid, by the assistance of heat, with the exception of a few blackish grains. These were at first supposed to be charcoal from the oxalic acid, but after being collected and ignited they proved to be platinum, weighing 0·45 grs.

D. The muriatic acid solution was now evaporated to dryness, and to insure perfect neutralization, heated, so that a small portion of the iron became insoluble on its being again digested in water. Into this muddy liquid a quantity of benzoic acid was thrown, and well stirred. After standing 24 hours the whole iron was found to be precipitated, while glucina remained in solution.* The benzoate of iron was collected on a filter, washed, dried, and ignited. The peroxide of iron obtained weighed 3·75 grs.=3·375 protoxide. On trial it appeared perfectly pure.

E. The residual solution was now mixed with ammonia, which threw down a white floculent precipitate. It was collected on a filter, well washed and dried. After ignition it had a dirty brownish white colour, and weighed 3·182 grs.

It dissolved in acids, forming very sweet tasted salts. The sulphuric acid solution

* It had been ascertained by experiment that benzoate of ammonia throws down glucina, which benzoic acid does not; and that, with care, the peroxide of iron may be completely thrown down by benzoic acid.

crystallized, though imperfectly. The solution gave the following characters with re-agents:

Prussiate of potash: No precipitate.

Caustic ammonia: A white precipitate, not soluble in an excess of the alkali.

Caustic of potash: A white precipitate, soluable in an excess.

Oxalic acid: No precipitate.

Oxalate of ammonia: No precipitate.

Benzoate of ammonia: No precipitate.

Tincture of nutgalls: A white precipitate.

Gallic acid: No precipitate.

The white matter obtained was therefore glucina.

The preceding analysis gave the constituents of gadolinite as follows:—

Silica. 6·220 24·880 Yttria 11·007 44·348 Protoxide of cerium 1·430 5·720 Glucina 3·182 12·728 Protoxide of iron 3·374 13·500 Platinum 0·450 1·800 Moisture 0·247 1·088. Total 25.991 104·064.

Suspecting that the increase of weight in this analysis, which rather exceeds 4 per cent., might have been owing to the yttria not having been sufficiently ignited,* it was repeated in the following manner:—

A. 30 grs. of the finely powdered mineral were boiled in a flask with nitro-muriatic acid till the whole was decomposed. The silica separated in the usual way, and most carefully washed with boiling distilled water, weighed after ignition, 7·3 grs. It was beautifully white and pure.

B. The residual solution was mixed sal-ammoniac, and evaporated to dryness. When again dissolved only a mere trace of platinum remained.

C. The solution was now mixed with oxalic acid, and, to ensure the precipitation of any manganese that might exist in the mineral the whole was evaporated to dryness. The white matter remaining undissolved on digesting the mass in water, after being well washed and ignited, weighed 15 grs. It was of a light-yellow colour.

D. It was dissolved in nitric acid. The solution was evaporated to dryness, the residue dissolved in a small quantity of water, and crystals of sulphate of potash were allowed to remain in the solution for a week. The clear liquid was then drawn off, and the white matter, after being well washed in a saturated solution of sulphate of potash, was dissolved in dilute nitric facid, and precipitated by ammonia and boiled in a flask, to ensure the complete separation of the sulphuric acid. The peroxide of cerium, after ignition, weighed 1·400 grs. = 1·3 grs protoxide.

E. The sulphate of potash solution from (D) was mixed with a solution of carbonate of ammonia in great excess. To what remained after the clear liquid had been drawn off fresh solutions were added, and this was repeated six times before the whole was dissolved. There remained only a few flocks, not weighing 0·01 gr. As they became black when dried they probably consisted of oxide of manganesè, but the quantity was too small to permit the use of re-agents to determine its nature.

The 15 grs. of white matter were therefore composed of Yttria 13·6, Peroxide of cerium 1·4 Manganese, trace total 15·0

F. The oxalic solution from(C.)was precipitated by ammonia, and the precipitate washed to get rid of the oxalic acid. It was then dissolved in muriatic acid. To separate the glusina from the iron, caustic potash, and then carbonate of ammonia were tried; but neither of these methods was found to answer. The separation was therefore accomplished by the same process as in the former analysis. There were obtained Peroxide of iron 4·53 4077 protoxide Glucina 3·47.

This analysis gives the composition of gadolinite as follows:— Silica 7·300-24·33 Yttria 13·600-4·533 Protoxide of cerium 1·300-4·33 Glucina 3·470-11·60 Protoxide of iron 40·77-13·59 Platinum trace-trace Manganese trace-trace Moisture 0·296-098. Total 30·043 100·17.

This analysis gives us the constituents of gadolinite as follows:—12·16 atoms silica 8·06 yttria 0·88 protoxide of cerium 3·91 glucina 3. protoxide of iron.

Were we to suppose the protoxide of iron to be an accidental ingredient, we might consider gadolinite as composed of 2 atoms silicate of yttria, 1 atom silicate of glucina and cerium. or we might consider it as composed of 1 atom silicate of cerium, 4 atoms silicate of glucina, 8 atoms silicate of yttria.

If the protoxide of iron be an essential constituent, the oxide of serium, glucina, and protoxide of iron must be in the state of disilicates.

II. EXPERIMENTS ON YTTRIA.

The neutral colourless sulphate of yttria was dissolved in water, and the solution, when treated by re-agents, exhibited the following properties:—

1. Prussiate of potash: A white chalky precipitate.
2. Ammonia: A white precipitate, hot soluble in excess.
3. Potash: A white precipitate, not soluble in excess.
4. Alkaline carbonates: A white precipitate soluble in excess.
5. Infusion of nutgalls O.
6. Gallic acid: O.
7. Tincture of nutgalls: White, merely from the alcohol.
8. Alcohol: White.
9. Chromate of potash: Yellow.
10. Bichromate of potash: O.
11. Hydriodate of zinc: O.
12. Sulphate of potash: O.
13. Oxalic acid: A white precipitate.
14. Oxalate of ammonia: A white precipitate.

When a solution of muriate of yttria was exposed to the galvanic action, chlorine was given out at the negative pole, and a small quantity of some other gas, (probably hydrogen) at the positive pole. A quantity of gelatinus matter collected round the negative wire.

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* We had found that the carbonate of cerium is not decomposed by exposure to a pretty strong red heat.

Yttria is not altered by having a current of sulphuretted hydrogen passed over it while heated to redness in a green glass tube.

When phosphorus in vapour is passed over yttria heated to redness, a vivid ignition takes place, but no combination is formed. The weight of the yttria remains unaltered.

To be continued.

ANALYSIS OF WOLFRAM.

By Mr. Thomas Richardson.

In 1781 Scheele discovered a peculiar substance in a heavy white mineral found in Sweden, to which he gave the name of *Tungstic acid* the base being called *Tungsten* from its weight. Shortly after this Messrs. D'Elhuyart obtained the same acid in a mineral called by the Germans wolfram, which had been analyzed in 1761 by Lehmann, who considered it to be a compound of iron and tin. Weigleb and Klaproth also analyzed this mineral, but nothing can with any confidence be drawn from their result, both of them having a deficiency of upwards of 21 per cent. Vauquelin repeated the experiments of the Elhuyarts in 1796, and obtained the following : Tungstic acid, 67.00 Protoxide of manganese 6·25, Protoxide of iron 18·00, Silica 1·50,92·75, Part of the iron Vauquelin supposes to be in the state of peroxide. But even if this supposition were adopted there would still be too great deficiency to warrant us in drawing any conclusion from the analysis. Berzelius published a set of experiments upon tungsten in 1815, and states the composition of this mineral to be according to his analysis : Tungstic acid 74·666 Protoxide of manganese 5·640, Protoxide of iron 17·954, Silica 2·100,100·000. The quantity of tungstic acid was determined from the loss, which prevents us from placing so much confidence in it as we could otherwise have done, from the known dexterity and precision of the analyst.

This mineral occurs generally along with tinstone, in veins and beds ; it is met with also traversing greywacké, with ores of lead, &c. It is found in almost all the Saxon and Bohemian tin mines, as also in several places in Cornwall.

It is thus found in France : In Siberia it occurs accompanying the emerald, and also in the United States of North America.

It occurs massive, and often crystallized. The primary form being a right oblique angled prism. The specimen subjected to analysis was from Zinnwald, in Bohemia, and seemed perfectly pure.

It possessed the following characters :—

Foliated ; not very brittle ; fracture uneven ; streak, reddish brown ; colour, blueish black ; lustre, approaching metallic ; opaque ; hardness, 5·0 to 5·5 ; sp. gr. 7·017.

Before the blowpipe, decrepitates when heated alone, but may be melted in a high temperature into a globule, possessing the metallic lustre.

With soda, on platinum wire, it fuses into an opaque green coloured bead in the oxydizing flame, which changes to pink in the reducing flame : with borax fuses easily into a transparent red coloured in the oxydizing flame, which becomes pale yellow in the reducing flame. With salt of phosphorus fuses readily into a transparent yellow coloured bead in the oxydizing flame, which becomes red in the reducing flame. On adding a small piece of tin to this red coloured bead and continuing the flame for a short time the colour changed to green.

It was analyzed in the following way :—

A. 20. grs. of the mineral, in fine powder, were kept fused with 60 grs. of carbonate of soda (anhydrous) for half an hour. The whole, upon cooling, was digested in water for 48 hours. The insoluble portion which remained behind was separated by a filter, and well washed with distilled water. The solution which came through the filter, together with the washings, being evaporated to a convenient bulk, pure nitric acid was added, and the tungstic acid precipitated of a beautiful yellow colour. After being well washed with distilled water, acidulated with nitric acid, dried and ignited, it weighed 14·39 grs., or 71·95 per cent.

B. The undissolved portion which remained on the filter in (A.) was dissolved off by muriatic acid, and the solution neutralized as exactly as possible with carbonate of ammonia. The whole was now boiled with benzoate of ammonia in a flask on the sand-bath, and the benzoate of iron which it precipitated was separated by a filter. After being clean washed, dried and ignited, the peroxide of iron which remained weighed 2.58 grs.= 2.362 grs. protoxide of iron.

C. The solution and washings from (B.) being evaporated to dryness, the whole was exposed to a red heat, to get rid of the ammoniacal salts. What remained was dissolved in water, and boiled with carbonate of soda. The manganese which precipitated was separated by a filter, and after being well washed, dried, and ignited, weighed 3.37 grs. red oxide = 3.137 protoxide of manganese.

Hence, we have for the composition as follows :—Tungstic acid 14.390 or 71.950 Protoxide of iron 2.362 ,, 11.810 Protoxide of manganese 3.137 ,, 15.985 Total 19.889 99.445

The difference between this and the preceding analysis of Berzelius induced me to make another, and the result of the second, executed, in the same way, gave as follows :—Tungstic acid 73·60, Protoxide of iron 11·20, Protoxide of manganese 15·75. Total 100·55. Agreeing with the first very nearly except in the quantity of tungstic acid.

If we adopt Dr. Thomson's atomic weight of tungstic acid, as given in the last Edition of his System of Chemistry, and calculate, we obtain the following:—

		atoms.
Tungstic acid............	4·74 or	1·90
Protoxide of iron.........	2·49 ,,	1·00
Protoxide of manganese...	3·50 ,,	1·40

Which approaches very nearly the following formula:

f^2 Tn. + $1\frac{1}{2}$ *mn.* Tm.

But, if we deduce the atomic weight of Tungstic acid from the last analysis, we have,

26·95 *(the whole bases)* :
4·5 *(an atom of base)* ::
73·60 *(the whole acid)* :
12·28 *(an atom of acid)*

Approaching 12·25 as nearly as can be expected from the inaccuracies incidental upon experiments. Employing 12·25 then, as the atom of tungstic acid, and calculating as before we get.

	atoms.		
Tungstic acid	6·00 or	2·41	nearly $2\frac{1}{2}$
Protoxide of iron......	2·49 ,,	1·00 ,,	1
Protoxide of manganese	3·50 ,,	1·40	$1\frac{1}{2}$

represented by the formula, f Tn. + $1\frac{1}{2}$ *mn.* Tn.

The difference between this and former analysis would lead to the opinion that they were different species, since both that of Berzelius and the present one agree exceedingly well, with the atomic proportions deduced from the formulæ by which they are represented.

Great doubt still hangs about the atomic weight of tungstic acid, and further experiments are required to elucidate the subject.

ON THE MEAN TEMPERATURE OF THE GROUND AT VARIOUS DEPTHS.

By F. Rudberge.*

At the end of December 1832, three thermometers, by my suggestion, and at the expense of the Academy of Sciences at Stockholm, were put in the ground at that place. They were filled with mercury, and were compared while in the vertical position with an accurate thermometer, so that the influence of the mercurial column was provided against. The thermometers were placed in glass tubes, which were shut at the bottom by perforated stoppers, and filled with fine sand. The depths at which the balls of three thermometers were placed, were one, two, and three feet respectively. The place where they were buried lies in the middle of that considerable plain on which the astronomical and now also the magnetical observatories are situated.

The observations began in December of the above year; but during the first six months they were made only once a day. After that, however, the thermometers were observed three times in the day, at 6 A. M. and at 2 and 9 P. M. As the natural equilibrium of temperature would of course be disturbed by digging up the earth, and a considerable time would be requisite to allow this to return to its usual state. I shall here omit the observations of the first half year, and state only those from the 1st. of July 1833, to the 1st. of July 1834. The monthly means of these are the folllowing :—

	Temperature at the depth of		
	One foot.	Two feet.	Three feet.
1833. July	60·548 F	59·000	56·966
August ..	55·616	55·456	55·184
September .	53·924	53·610	53·474
October ..	48·146	48·344	49·262
November ..	39·002	40·316	42·206
December..	33·458	35·186	37·004
1834. January..	29·282	31·244	32·720
February ..	31·316	31·964	32·432
March	32·640	33·134	33·440
April	38·041	37·436	36·932
May	48·020	46·562	45·104
June......	56·570	54·500	52·312

If we take the mean of the result of each thermometer, then will the mean annual temperature of the ground at Stockholm be,

At the depth of 1 foot 43·880
" 2 feet 43·898
" 3 feet 43·906

Whence it follows *that the mean temperature of the ground*, at least to the depth of three feet, *is independent of the depth ;* and in all probability this proposition will be correct for all depths, till the point where all variation of temperature ceases.

The table shews, besides, that temperature at the end of September and the end of march, or at the time of the vernal and autumnal equinox, is the same at all these depths.

Although more observations may be required to settle these two propositions, I have, nevertheless, thought it proper to draw the attention of meteorologists to them that they may try their accuracy in other places.

This mean temperature of the earth is greater than the mean temperature of the air at Stockholm, which is only 42·24 F.

* From Pogg. Ann. xxxiii. 251.

ASHMOLEAN SOCIETY OF OXFORD, 1835.

THE FIRST MEMOIR PRINTED BY THIS SOCIETY IS ENTITLED, " ON THE ARCHROMATISM OF THE EYE. By the Rev. Baden Powell, A. M., &c.

It is well known that when rays of light are inflected by a lens they undergo a deviation, by which they are prevented from concentrating in the same point or focus. This aberration gives origin to the production of colour at the foci of lenses, and constituted a great imperfection in refracting telescopes until the discovery was made, that a compensation for the deviation of the rays of light might be effected by employing compound lenses. Those telescopes in which this improvement was introduced were termed achromatic. Now, as there appears no compensation in the eye for this aberration, it is natural to inquire into the reason of our seeing objects without prismatic colour. Such is the question which Professor Powell undertakes to investigate in the present paper. He presents us first with

the opinions of various philosophers in reference to the subject, and then supplies us with inferences drawn from his own experiments. D'Alembert admitted the want of achromatism in the eye, but considered the aberration very small. Euler held an opposite opinion, and Dr. Maskelyne refuted the arguments of Euler. Dr. Wells has observed that the eye has no principle of achromatism, and Sir David Brewster says that "no provision is made in the human eye for the correction of colour, because the deviation of the differently coloured rays is too small to produce indistinctness of vision." Mr. Coddington states that the eye, when employed in its natural and proper manner, is achromatic. The fact is, that we see objects without the slightest degree of prismatic colour or indistinctness. The question then is, how can this be reconciled with theoretical considerations? Mr. Powell, by ingenious calculations, has inferred that in such a combination as the eye, exact achromatism is perfectly possible in theory, and that the principle of its achromatism, although not effective in oblique excentrical rays, may be in general achromatic for direct rays. He gives the results of a series of experiments, in which he has "endeavoured to ascertain directly the actual prismatic dispersions of the crystalline and vitreous humours, by measuring micrometically the separation of the different parts of the spectrum of a line of light produced by looking through a prism formed of each medium, from the eye of an ox, between inclined glass plates." From which he concludes "that the media of the eye have as nearly as possible those dispersive powers and relations of indices for the different rays, which theory requires for producing achromatism by means of a single lens, when the focus is formed in a dense medium."

MR. TWISS OF UNIVERSITY COLLEGE EXHIBITED SOME SPECIMENS OF THE PAPYRUS FROM SYRACUSE.

February 13, 1835.—Both in its natural and manufactured state. He read some observations upon it, describing the locality where the plant grows on the banks of a small stream issuing from the fountain of Cyane, near Syracuse. It is now manufactured merely as a curiosity.

Some discussion took place on the supposed identity of the papyrus with the lotus.

MR. TWISS EXHIBITED TO THE SOCIETY A SERIES, ALMOST COMPLETE, THE SILVER AND BRONZE COINS OF THE ROMAN REPUBLIC, AND READ A DISSERTATION UPON THEM.—In this paper the author commences with observing the gradual decline in weight of the As from the time of the kings through the successive ages of the republic. The value of the copper is compared with that of the silver coinage; and the author is of opinion that the rise in the value of copper is chiefly accounted for from the diminution of the supply, both from the exhaustion of the mines, and the interruption of the commerce with the Carthaginians, as well as from the circumstance of copper being re-exported to Sicily; these causes acting more powerfully about the time of the second Punic war, when the As was diminished to an ounce, from its original weight of ten or twelve. The last diminution, to half an ounce, took place in the time of Sylla. Silver was introduced into the currency after the conquest of Compania and Lower Italy. Observations are made on the silver coinage, and particularly on the devices appearing on them: and the author then gives a general sketch of the financial arrangements, and state of the currency, at successive periods of the Roman history.

A PAPER WAS READ BY THE REV. E. T. BIGGE OF MERTON COLLEGE ON THE NATURAL HISTORY OF THE WASP.

February 27*th*.—The object of this paper was to correct the mistakes into which several writers have fallen, and to state the results of the author's own observations on two species, the Vespa Vulgaris and Vespa Britannica.

The former is common in all parts of the kingdom; the latter, though occasionally met with in the southern counties of England, is abundant in the northern districts, and in Scotland, as well as in the northern parts of Europe. The V Vulgaris of Linneus is the V Britannica, the French having called that species *vulgaris*, which was most common, and which formed its nest in the ground. The V Vulgaris of the present entomologists is the V Gallica of Linneus.

Leach gave the name Vespa Britannica to the tree wasp. The points of difference beween the two species are as follows:—

1. The tree wasp (V Britannica) has a reddish-brown spot near the point of insertion of the wings, which is seldom visible in dried specimens.

2. In the males and neuters the base of the antennae is yellow on the outer side, instead of being entirely black, as on the ground wasp, but the females often present exceptions to this distinction.

3. The tree wasp has two yellow spots on the back part of the corslet, while the ground wasp has from four to six.

4. The spots on the abdomen of the tree wasp are not so much detached from the black bands as in the other species, and less so in the males than the females. Linneus drew a distinction between the hornets (V Crabro) and the true wasps, founded on these marks, which cannot be considered as decisive, because they vary in different individuals.

5. The tree wasp has more black upon the body generally than the other species.

6. The tree wasp is rather larger. 7. The organs of generation in the males of the two species vary considerably. 8. The abdomen in each species contains the same number of rings, viz. six in the females and neuters, and seven in the males.

Mr. Bigge states some interesting facts in illustration of the natural history of both species. Societies of wasps, as of bees, consist of three different classes of inhabitants, males, females, and neuters. The females, which are much larger than the others, are

the large breeding wasps which appear in the spring. The neuters, or imperfectly developed females, are the common wasps which infest our houses and gardens, and form the majority of the colony. The males, about the size of the neuters, have longer antennae, a more slender form, and are destitute of a sting. The females, which alone survive the winter, early in the spring, having fixed on a suitable place for a nest, form a few cells, in which they lay the eggs of neuters only. Each nest is the work of a single female. The nests are often suspended from the beam of a shed, from the eaves of a house, from the branch of a young tree, or in a thorn hedge.

Mr. Bigge has observed them in the Scotch fir, elm, and beech, very frequently in larch trees, and still more so in gooseberry bushes, but never in the silver fir, as stated by Mr. Renni.*

The nest consists of from ten to sixteen layers of a paper like substance, procured principally from fir wood, and disposed one over the other in such a manner that each sheet barely touches the next. The structure enables it to resist the haviest rains. In its earliest state it does not exceed an inch in diameter, and contains five or six cells only.

It is formed of two semicircular layers of the paper, the upper one projecting a little over the other, so as to shoot off the rain, a hole being left at the bottom large enough to admit the female wasp. As soon as the first workers quit their cells, they begin the task of enlarging the nest, and of adding fresh layers of cells, in which the female immediately deposits more eggs. Mr. Bigge states that the nest is enlarged from one inch to twelve in diameter, and considers that Leach is in error when he affirms that wasps build two nests in the year.

Is not the loose structure of the external covering intended to facilitate its expansion?

The egg is hatched in eight days, and then assumes the form of a grub. It is then fed by the female for thirteen or fourteen days, when the grub covers the mouth of its cell with a silky substance. It remains in this state for nine days, and then eats its way through the covering and joins the rest in the labours of the nest. As soon as the neuters are hatched the care of feeding the larvæ devolves upon them. The males appear to employ themselves in cleaning and preparing the cells for successive broods.

Mr. Bigge has never found, in any single instance, a male larva in the cells appropriated to females. He has repeatedly found male grubs in the upper layers, which are devoted to neuters, but never the contrary. The beautiful arrangement by which the layers in the nest are attached to each other so as to allow room for the wasps to walk between them deserves attention. In the ground nests the supports or braces are round, like small columns, and dispersed at irregular distances. The upper end is spread along the edges of three cells so as to divide the pressure, and yet allow room for the grubs to work their way out when they are of pillar like braces, thin slips of the paper of which the whole nest is composed but made stiffer for this purpose, are continued along the edges of a number of cells, so as not to interfre with the inmates, and are finally fixed to the layer below.

The autnor has never seen a nest of either species, in which he did not observe after 9 o'clock in the summer months, a sentinel watching the entrance to the hive. He has sometimes thought, that he could discern a second sentinel, behind the first one. A lantern held near the sentinel does not disturb him, but on touching the ground near him, he instantly disappears for a few seconds, and the inhabitants sally out immediately. Several wasps pass the night in summer on the outside of the tree nest, but the centinel is notwithstanding always at his post.

The ground nest has two apertures, one for entry, and the other for exit. The tree nest has usually only one, but in large colonies there are two, at each of which a sentinel is stationed. It is curious, that, if we stop up a wasp's nest, the returning wasp will not sting the aggressor, while those which escape from the inside will attack him instantly. The grub of a species of volucella is found in the nests of wasps. An ichneumon as large as the wasp itself, with a black head, yellow abdomen with a dark streak down the back, black legs, and under wings, and dusky upper wings has been observed by Mr. Denison, and another (Anomalon Vesparum) by Mr. Wood.

Mr. Twiss mentioned a peculiar kind of wasp's nest which he had observed on the Cactus in Sicily. The author suggested the query, whether it was not the Epipone Fidulans, sometimes found also in England.

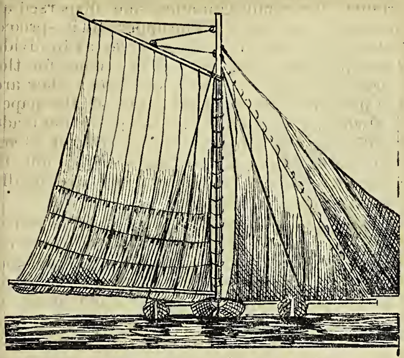
(To be continued.)

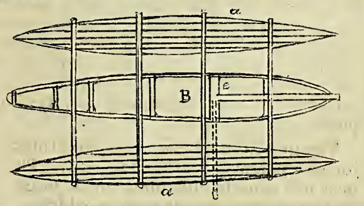
* I have frequently observed nests situated on wild rose bushes (Rosa *tomentosa and canina*,) (in Scotland. The choice of these shrubs by the wasps is probably to be ascribed to the facilities which they afford for obtaining food. Edit.

PLATE-GLASS.—A French paper states, that the largest piece of plate glass ever manufactured has just been finished at St. Gobin. It is 175 French inches high by 125 wide. At the last Exhibition at the Louvre, the largest plate shown was 155 inches by 93

THERMOMETERS.—Professor Johnson exhibited some alcohol and mercurial thermometers constructed by him of large size and admitting of graduation to hundredths and even two hundredths of a degree Fahr. He showed a curious fact not noticed in descriptions of the thermometer, namely, that the first effect of heat on one of these instruments is to cause a fall in the liquid, and the reverse on reducing the temperature—effects produced as was explained by the expansion and contraction of the glass.—*Monthly Meeting Franklin Institute.*

SAILING AND ROWING TREBLE BOAT.





Sir,—I beg through the medium of your valuable journal to show to the public one way by which the principle of twin-boats may be applied, if not to any extent of usefulness at least in making an addition to the recreations of amateurs in rowing and sailing, and, therefore recommended to those who are fond of *both.*

The plan in question has for its object to unite sailing and rowing, in the most convenient manner, so that any person or club possessing a rowing-boat of any description, from a twelve-oared galley to a wherry or skiff, may contrive to make a good sailing-boat, and still have her in readiness for use as a rowing-boat, perfectly unencumbered with masts, sails, ballast, &c.; in fact, in the same state as if she had not been used for sailing.

The proposed sketches will sufficiently elucidate my meaning, it being quite unnecessary to determine upon the shape, size, or dimensions, of the twin-boats, which may be formed to suit all fancies, for the attainment of whatever good quality they may be required to possess.

AA are the twin-boats, which may be of such capacities and distances asunder as may be judged proper for stability. B is the row-boat, which is placed in the centre between the others, and secured to the beams by screws passing through them into her gunwales, or by their passing through the beams with screw nuts, or any other simple and convenient method, thus forming a treble-boat. Although the central boat offers herself conveniently enough for housing the mast, I do not take advantage of it, because it would be a hindrance to using the boat with dispatch; besides, it is of little consequence, as owing to the great spread of the rigging, very little housing would be necessary, a wooden shock fixed to one of the beams, or a low thwart from one beam to the other, would answer every purpose. Fig. 2 shows how she may be rigged as a cutter, for instance, and she is represented as sailing directly before the wind, with her bowsprit, containing her fore-sail and jib spread over on the opposite side of her main-sail, which is made to revolve at its inner end C, fig. 1; and when the boat is sailing upon a wind, it is secured to the stern by a clamp, by which method the necessity of a square sail is avoided, a plan of this nature being manageable enough upon a small scale; however, as the rigging part has nothing to do with the first intention of the plan. I leave that entirely to the judgment of the amateur.

After the above explanation, it will be readily imagined that the central boat is always in a state of readiness, and when it is considered that the largest class of yacht cutters cannot conveniently stow a large galley, the convenience of the plan is obvious; by way of an example, I will suppose a club of gentlemen having a rowing galley, and being desirous of making a long excursion coastwise, or from one river to another, now instead of over-fatiguing themselves by rowing the whole of the distance, they might anchor the treble-boat in a place of security at the mouth of one river, and row up the other, which latter may be supposed to be too narrow for the treble-boat to work up, and the same reasoning would hold good for those who possessed Thames, wherries, or small skiffs. As the twin-boats would be decked out and made water-tight, the sailing would be attended with the safety of a life-boat. When the treble-boats, too, were on such scale as, to exceed the length of 25 feet, the twin-boats would then be capacious enough for the accommodation of sleeping-berths,—small cabins, as their owners might think fit, properly shut in with hatch-ways.

I can recommend the plan the better from having *tried it;* therefore, an observation or two, as to how she works, may not be amiss. The display of good judgement all depends upon the distance of the twin-boats from each other, together with their capacities suiting whatever weight of mast, rigging, and quantity of convass it is proposed to give the boat.

Should the twin-boats be of small capacities and too far asunder, the longitudinal stability or liability to turn over in sailing before the wind may be less than the lateral, or that required in sailing upon a wind; this is the point in which the stability differs so widely from single boats. I have read in some publication that it would be next to impossible for a twin-boat to be upset, but that is a fallacy, as *any vessel* may be masted and rigged in proportion to her stability, which I have learnt by experience for having so masted my treble-boat, as to oblige me to take in reefs when other vessels did, I was once all but upset; the lee boat was apparently entirely submerged, and it is clear that the maximum of stability must be in that

situation, with the whole weight of the weatherboat suspended in the air,, when, if sail be not immediately reduced, a rapid capsize must follow, unlike to a well-ballasted boat which would be finding her equilibrium. It is true that a treble-boat may be under-masted for her stability and still answer every purpose, and then her comparatively superior stability would become her best coasting quality, and if with a moderate breeze she outsailed every other boat of her length, that would certainly be the most prudent course to adopt. I only mean to remark, that treble-boats similarly to single ones may be adapted either for safety, convenience, or racing, and that many good qualities are only attainable but at the expense of others.

The experience which I gained with my treble-boat (14 feet only in length) was, that in sailing free or before the wind, she flew past every other boat, and she forereached and worked well to wind-ward, but did not hold a better wind than in common, which I ascribed to the circumstance of her stability having been gained by great breadth of beam with no weight of ballast, and, consequently, her presenting above the water-line so much more surface of hull than a well-ballasted single boat would have done; however, there is no determining upon the achievements of a boat of larger dimensions than mine. I had only two strong beams to unite my little treble-boats together; of course, longer boats would require more, but it is only on a large scale that it would be indispensable to resort to stronger combinations of unity, as diagonal trussing, &c. As it is advantageous to have the twin-boats a good depth, and, at the same time, a proper height out of the water, I should recommend to any person who may construct one upon a large scale, not to mind should the height of the beams require the central boat to be lifted out of the water, or merely, to skim upon the surface, when she is bolted to them, as she would not add much to the stability, but on a small scale she cannot so well be got rid of, and her services must not then be despised.

Notwithstanding my having said that the present plan can only benefit the recreations of aquatic amateurs, that I might not appear to give it more importance than it merits, I think that it is one of the many of those plans which every naval officer should make himself acquainted with, to enable him to have recourse to, in case of need. I can conceive many situations a ship may be placed in, which would call it into action, especially in the survey of coasts and rivers in foreign parts, when at any time with the materials she had on board a ships cutter might form the central boat of a very respectable treble one, possessing all the advantages already pointed out. Again, if a ship were standed on a desolate coast without the loss of her materials, she could make all her boats treble ones with sufficient capacities to convey the whole of her crew with a certain quantity of provisions and water to any other place of safety.

I cannot conclude without remarking, what a pity it is that a book containing nothing but naval inventions and plans relating to nautical matters, has not been published for the exclusive use of seamen, as many plans, particularly "make-shift" ones, which have answered admirably, and others which have been proposed are buried in oblivion, leaving the officer in the time of difficulty to the resources of his own mind, unassisted by the labours and experience of the many.

In the hope that I have sufficienly explained the plan, and that the above hint may be taken by some one of your intelligent readers who may have the means of compiling a work of the kind.

I remain, Mr. Editor,
Your faithful servant,
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June 12, 1835.

THE RAILROAD SYSTEM IN AMERICA.

The *New Brunswick Fredonian* says :—"Railway stocks are all the go now a-days among the speculators and capitalists. A few days since books were opened in Philadelphia for subscription to the stock of the Lancaster, Portsmouth, and Harrisbugh Railroad. In thirty-one minutes every share was taken, and a large number applied for beyond the ability of the Commisioners to supply. The stock of the New Jersey Railroad and Transportation Company is gradually advancing to its real value. It is eagerly sought after now at 126, and will, it is believed, not stop much, if any, short of 200*l*. The stock of the Camden and Amboy Railroad is also selling at an advance of something like 60 per cent.

POWER OF THE SCREW.— There is a screw-dock in New York, at which a ship weighing 200 tons can be raised a height of two feet in thirty minutes by the power of only fifteen men applied to the screws.

PRODIGIOUS FORCE OF EARTHQUAKES.—An English merchant ship, which was nearly four miles from the land (at the time of the late earthquake in Chili), and going seven knots, seemed in a moment to be arrested, and her bottom grated as on a hard sand. So perfect was the illusion, indeed, that the master was in the act of lowering his boats to save the crew, considering the vessel irrecoverably wrecked on a bank when it was ascertained that there were no soundings even at ninety fathoms!—*Extract from a private Letter in the Athenæum.*

EVAPORATION OF PLANTS.—Forests cool the air by shading the ground from the sun, and by evaporation from the boughs. Hales found that the leaves of a single plant of helianthus, three feet high, exposed nearly forty feet of surface; and if it be considered that the woody regions of the river Amazons, and the higher part of the Oroonoko, occupy an area of 260,000 square leagues, some idea may be formed of the torrents of vapour which arise from the leaves of forests all over the globe. However, the frigorific effects of their evaporation are counteracted in some measure by the perfect calm which reigns in the tropical wildernesses.—*Mrs. Somerville.*

SPECIFICATION OF THE PATENT GRANTED TO JAMES MICHELL, OF TRURO, IN THE COUNTY OF CORNWALL, GENTLEMAN, FOR AN IMPROVED PROCESS IN SMELTING ARGENTIFEROUS ORES.

Sealed June 22, 1835.

My invention consists in the process hereafter described, of submitting successive charges of calcined argentiferous ores to be fused with the sulphuret produced by a previous charge of calcined argentiferous ores in admixture with sulphur or with iron pyrites, till sufficient silver is concentrated, or where the argentiferous ores contain sufficient sulphur, then after the first charge of uncalcined ore has been fully smelted and the slag removed, the process hereafter described of submitting successive charges of calcined argentiferous ores to be reduced and concentrated by the sulphuret obtained by the smelting of the first charge of the furnace.

Having thus stated the nature of my invention, I will proceed to explain the best manner I am acquainted with of performing my said invention. The smelter having ascertained the composition of the various parcels of ore to be smelted, and having ascertained the best mixture which will give the whole when in a melting state the greatest degree of fusibility, all which is well understood and commonly practised, he calcines the mixture so made in order to sublimate the sulphur and arsenic, and to decompose the earthy oxides this process should be continued till nearly the whole of the arsenic and sulphur are expelled. These remarks relate to argentiferous ores which before calcining do not contain sufficient sulphur for the first charge, and to receive subsequent charges of calcined ore as hereafter described.

The argentiferous ores when calcined are found better for the after process of fusion if left exposed to the influence of the atmosphere for a week or more.

The smelter proceeds to charge a reverberatory furnace, with a quantity of the calcined ore (say one ton), together with the usual fluxes, such as lime, flour, &c. These are to be intimately blended with about three cwt. of sulphur, or otherwise with six cwt. of iron pyrites. This mixture is to be submitted to an intense heat until the whole is brought into very perfect fusion, when the silver will subside from the sillicates and other earthy oxides, constituents of the slag, into the sulphuret. The slag thus freed from the silver is to be skimmed or tapped off very carefully from the surface of the metallic sulphuret, taking care that as little as possible of the sulphuret is removed in the process of tapping or skimming. Another charge of calcined ore alone (about one ton), is to be put into the furnace with the fused metallic sulphuret produced by the former charge, and the whole is to be brought to a perfect state of fusion, the concentration of the silver contained in the second charge of calcined argentiferous ore will take place, the slag is again to be removed by skimming or tapping, and this process of adding charges of calcined argentiferous ores, is to be continued without further addition of sulphur or of iron pyrites after the first charge, till the smelter considers there is a sufficient quantity of silver concentrated, which he will readily ascertain by testing the slag, and when he ascertains it to contain, in assaying it, as much as two to two and a half ounces of silver to the ton, he should stop all further additions of calcined argentiferous ores to the fused sulphuret in the furnace, as the sulphuret will then be so charged with the silver as to materially reduce its powers of concentrating more from future charges of calcined ore, without leaving the slags so rich of silver as to materially lessen the benefit of adding such additional charge after the slag has been found to have come off of the richness before mentioned. The charge of sulphuret is then to be tapped off from the furnace for a future operation with lead, for which purpose it must be pulverized (if it has not been granulated by tapping into a pit of water) and calcined, and it will be the better for being submitted to the atmosphere for a week before submitting the calcined sulphuret to the further process, after which the lead may be added and fused with the calcined sulphuret in another reverberatory furnace, and the silver refined by cupeltation as is well understood.

It should be remarked that each charge should be well stirred when in a state of fusion, and afterwards remain some time, say twenty to thirty minutes, before the slags are skimmed or tapped off, and also that each successive charge of calcined argentiferous ores should be mixed with the usual fluxes, and for this purpose it will be found desirable to have a large heap of calcined ore, well mixed with fluxes, as is well understood.

It will only be desirable further to remark, that in case the first charge of argentiferous ore in an uncalcined state, containing sufficient sulphur, be used in place of the application of sulphur to calcined argentiferous ore, as above described, then to the sulphuret produced by the fusing of the same successive charges of calcined argentiferous ores are to be added according to the process above described. I, however, prefer using calcined argentiferous ores with the addition of sulphur or of iron pyrites, as above described, but by either means of performing the process considerable saving will take place in the process of reducing argentiferous ores. And I would have it understood that although I have stated three cwt. of sulphur or six cwt. of iron pyrites to one ton of calcined argentiferous ore for the first charge of the furnace, I do not confine myself thereto, but only state such relative proportions as the best I am acquainted with.

Having thus described the nature of my invention, and the manner of performing the same, I would have it understood that what I claim as my invention is the process of submitting successive charges of calcined argen-

tiferous ores to be fused with the sulphuret produced by the previous or first charge, whether such sulphuret be the result of applying sulphur or iron pyrites to calcined argenitiferous ores, or the result of argentiferous ores, containing sufficient sulphur as above described. In witness whereof, &c.

Enrolled December 22, 1835.

SPECIFICATION OF THE PATENT GRANTED TO JAMES VINCENT DESGRAND, OF SIZE LANE, IN THE CITY OF LONDON, MERCHANT, FOR A CERTAIN METHOD OF WEAVING ELASTIC FABRICS.

I, the said James Vincent Desgrand, do hereby declare that the said invention of a certain method of weaving elastic fabrics, consists in the weaving of such fabrics in any suitable looms of ordinary construction, with bare or uncovered strings or cords of caoutchouc or India-rubber interwoven, if necessary, with any of the kinds of spun threads or yarns which are commonly used in weaving, whether composed of silk, cotton, flax, wool, or other fibrous materials; the said bare strings or cords of caoutchouc or India-rubber being in all cases used in the said method of weaving elastic fabrics, without applying any previous covering of silk or other thread around such strings or cords. The said bare strings or cords of caoutchouc or India-rubber being in some cases used to form the warp of the elastic fabric, spun threads or yarns of any suitable fibrous materials being used for the weft, or as part of the weft; or in other cases the said bare strings or cords of caoutchouc or India-rubber being used for or as part of the weft, the warp being composed of spun threads or yarns. Or in other cases such cords or strings of caoutchouc or India-rubber being used both for the warp or as part thereof, and also for the weft or as part thereof. And the said weaving of bare or uncovered strings or cords of caoutchouc, either with or without combination with spun yarns or threads of any of the kinds usually woven, in looms may be performed in looms of the ordinary construction by the ordinary manipulations of weaving other fabrics, those manipulations being conducted with the aid of certain precautions which I will hereinafter point out. The elastic fabric produced by the said method of weaving bare or uncovered cords or strings of caoutchouc or India-rubber will possess more or less elasticity in one or both directions according to the quantity and arrangement of the uncovered caoutchouc strings or cords that are interwoven into the said elastic fabrics; the aforesaid caoutchouc cords or strings are formed in the same manner as heretofore practised for producing such cords or strings, viz., by cutting caoutchouc or India-rubber into thin strips, and stretching them out in length and winding them upon bobbins or reels, where they are left for a sufficient time until they have entirely or in great part lost their natural elasticity.

And as before stated they may then be woven according to the aforesaid method either alone to produce an entirely elastic fabric or they may be combined in several ways with spun threads or yarns of other kinds of materials to produce partly elastic fabrics. By way of example I will state some of the kinds of elastic fabrics which may be woven according to the said method.

For instance, I sometimes form the warp entirely of bare cords or strings of caoutchouc, or else it may be partly of such cords or strings and partly of spun yarns or threads of suitable material, and I introduce that warp into a loom of an ordinary construction, which is harnessed suitable for the textury of the fabric that I intend to weave; and I work the loom so as to cause the warp to be opened and separated by the harness in a proper order for all the bare cords or strings of caoutchouc in the warp, as well as the spun yarns or threads that may form a part of the warp, to be more or less covered and concealed by the threads of the weft: the latter being, in this case composed of spun yarns, or threads of cotton, silk, worsted, or other like fibrous material. When the warp consists as aforesaid of strings or cords of bare caoutchouc with spun yarns of some other material intermingled, the spun threads or yarns of such material are wound on a separate yarn-beam from the beam whereon the cords or strings of caoutchouc are wound, and all the yarns, cords, or strings, that are to form the warp, are brought from their several beams through the eyes of the proper heddles, with suitable arrangement to produce the kind of fabric desired, whether the same be dimity, or satin, or twilled stuff, or other of the fabrics woven usually in looms of known construction. Another kind of elastic fabric may be woven by the said method, by forming a portion of the warp of spun threads or yarns of cotton or silk, or other like filamentous material wound on one or more yarn-beams, and another portion of the warp of cords or strings of bare caoutchouc wound on another beam. The said strings or cords of caoutchouc and spun yarns or threads being properly intermingled and brought together into one warp in the loom, and the loom being so harnessed and worked, that in the woven fabric, the caoutchouc cords or strings will be enclosed between two complete webs or woven fabrics, one above them and one below them, the shuttle being thrown sometimes above and sometimes below the caoutchouc cords or strings; and the order of the opening of the warp is such, that the spun threads of cotton, or silk, or other like material in the warp, or certain of the same, pass in and out from the upper web to the lower, that is, the same warp-thread will be found in the woven fabric to pass over one of the weft-threads of the upper web, then down between the berecords or strings of caoutchouc of the warp, and under a weft-thread of the lower web, and then up again, and so on. The bare cords or strings of caoutchouc are thus separated one from the other in the woven fabric,

by the cotton or other kind of spun warp-threads interposed between them; and the upper and lower web are united, so that the woven fabric produced will be a double tissue, with strings or cords of bare caoutchouc included between the two tissues, and running in the direction of the warp; these two tissues being sufficiently united and tied together by the weft-threads to unite them as one, without confining the strings or cords of caoutchouc.

Another kind of elastic fabric may be woven according to the said method by arranging in the loom one or more warps formed of cotton, silk, or other like spun yarns, and either using bare cords or strings of caoutchouc to form the entire weft, or else by using two or more shuttles, one containing bare cords or strings of caoutchouc, and the others containing cotton, or silk, or wool, or other like kinds of spun yarns. The loom being harnessed and worked in a proper manner to cause the threads of the warp to cover entirely the caoutchouc cords or strings of the weft. I sometimes use bare cords or strings of caoutchouc, both to form the warp and the weft, without any admixture of any spun yarns of cotton, silk, or other material. The fabric woven by this method will be very elastic in every direction, and may, after being woven, berendered waterproof, as will be hereinafter described. By weaving with a double warp (in the way before-mentioned as being used to produce a double stuff with cords or strings of bare caoutchouc inclosed within it), but without uniting the two webs, as there described, by all or some of the spun warp-threads of each web, passing in and out between the weft threads of the other; and by harnessing the loom in the way usually practised for weaving tubular webs for bolting cloths or sacks without seams, I can produce elastic pipes or tubular webs without seams; and if they be woven entirely of bare cords or strings of caoutchouc they may be rendered waterproof, by the means hereinafter described. That is to say, in order to render waterproof the elastic fabrics woven by the said method with bare cords or strings of caoutchouc, without the admixture of any spun yarns of cottom, silk, or other material, I dip them in boiling water, or sprinkle boiling water over them, and then I subject them to strong pressure. The effect of this process is to cause the several bare caoutchouc strings or cords of which the woven fabric is composed, to agglutinate together, and thus to make it very impenetrable to water. Note—The cords or strings of bare caoutchouc being strained, as aforesaid, to their utmost tension before being used in the loom for the said method of weaving elastic fabrics so as to have lost in great part their natural elasticity, the fabric woven in the loom will possess but little of the intended elasticity immediately on quitting the loom; but it is afterwards rendered again elastic by the application of heat, that is to say, by ironing the said fabric with a heated iron, or passing it around or between heated cylinders. The heat thus applied causes the caoutchouc strings or cords to shorten. Hence, if they form the warp, the stuff will lose in length by such application of heat; if they form the weft, the stuff will lose in breadth; or, if they form part, or the whole, of both warp and weft, then the stuff will contract in both length and breadth. The amount of contraction of stuff, in any of the kinds of weaving above described, should be ascertained at first by trial, before commencing to weave a large quantity of goods, and then according to the result observed, an allowance should be made in setting up the loom for the particular kind of stuff, and the particular kind and fineness of caoutchouc cord or string used therein; that is, if the caoutchouc cords or strings are in the warp and not in the weft, the beat up of the lay should be regulated so as to beat up the threads of the weft more or less close together according to the contraction that will take place in the caoutchouc cords or strings of the warp; and vice versa, if the caoutchouc cords or strings are in the weft only, then the threads of the warp should be laid more or less close together in the loom, accoding to the degree of contraction that will take place in the caoutchouc cords or strings of the weft. It is obvious that no precise directions can be given on this head, but the fact being pointed out, it must be in the discretion of the weaver to set up and work his loom according to the quality of the bare caoutchouc cords or strings that he uses, and the peculiar arrangement that they may be intended to have in the stuff that he is going to weave. Note—I have sometimes found it advisable, in order to give the caoutchouc cords or strings an equal degree of tension in the loom, instead of winding them on a yarn-beam, to wind each separately on a bobbin, all the bobbins being loaded with equal weights, that they may draw off with an equal tension in the weaving. Also to prevent the puckering, or rucks, or inequalities which might arise in the stuff, notwithstanding the precautions taken to strain the bare cords or strings of caoutchouc equally, I sometimes introduce at each selvage a cord or string of caoutchouc or India-rubber thicker then those contained in the staff; and sometimes a wire (which I have found better), which wire is withdrawn as the work advances, but serves during the weaving to prevent the India-rubber cords or strings from being pressed more at one shoot of the weft than at another. And. note.—To cause the bare cords or strings of caoutchouc to pass smoothly and freely through the dents or spilts of the reed, without getting shagged or roughened, which they are apt to do if no precaution be taken to prevent it, I apply to them in the loom when the warp is formed thereof, hogs' lard, or other like greasy material.

It will be seen by the foregoing description, that the method of weaving elastic fabrics, described therein, is applicable to the weaving of elastic fabrics of any texture, usually woven in looms of the ordinary and known constructions; and it is obvious, that various patterns may be produced by varying

the colours and arrangement of the spun yarns of cotton, silk, or other material, used in weaving various fabrics.

And the bare cords or strings of caoutchouc that form the warp or weft, or both, or a part of either, in the elastic fabrics woven in such looms, may be combined with yarns or threads of any other materials, with which the quality and degree of fineness obtainable in the bare cords of strings of caoutchouc may render them fit to be mingled and worked. On the character and extent of these combinations no precise directions can, from the nature of the subject, be given, but they must be left to the discretion of the weaver.

And whereas cords or strings of caoutchouc have been heretofore used in various ways for composing elastic articles, as for instance, by introducing such caoutchouc cords or strings in the said articles to act as springs, the same being contained in pipes or cases of leather, linnen, or cotton, or other similar material, in the manner described in the specification of a patent granted to Thomas Hancock, on or about the 29th of April, 1820.

And whereas such caoutchouc cords or strings covered by platting, winding, or otherwise with cotton, or silk, or other like filamentous material, have, or may have, been combined by laying them together, or platting, or interlacing, or netting them together, to form cables, ropes, lines, bags, and other like fabrics or articles, as described in the specification of a patent granted to Robert William Sievier, on or about the 1st day of December, 1831.

And whereas also, such caoutchouc cords or strings so covered with cotton, or silk, or other like material, have, or may have, been woven in combination with cotton, or flax, or other similar yarns, to produce a fabric partially elastic; but bare cords or strings of caoutchouc have not been heretofore used in the warp or weft of a fabric woven in looms of any ordinary construction, and with the usual modes of harnessing such looms.

Now I do hereby declare that I do not claim the use of cords or strings of caoutchouc when the same are so coverd with silk, or cotton, or other like material, wound, platted, or otherwise laid around them; or when the same are used merely as springs, or in any other way than that I have described hereinbefore. I claim only the method, which I have described, of weaving elastic fabrics with uncovered or bare cords or strings of caoutchouc or India rubber in looms of any of the ordinary constructions; the said bare cords or strings of caoutchouc forming either the entire or any portion of the warp or of the weft, or of both the warp and the weft of such elastic fabrics.—In witness whereof, &c.

Repertory of Arts 1836.

ON WATER AS A SUBSTITUTE FOR STEAM.

Mr. Editor,—On perusing Mr. Galt's "substitute for steam power," No. 629, p. 403, and the subsequent remarks of "Hydraulicus," No. 631, p. 460, I was reminded of an attempt made about two years ago by myself and an engineer, who has since constructed for me a steam-carriage, to employ water on the principle of Bramah's hydrostatic-press, as a substitute for steam. My object was to propel a slow heavy cariage as a substitute for the carriers' waggons in present use. The experiment may be said to have failed: the utmost velocity that the experiment promised, supposing all intermediate difficulties could have been successfully combated, would not have exceeded a quarter of a mile an hour—too slow for my purpose. The same ideas, or some modification of them, seem to have presented themselves to Mr. Galt and to Hydraulicus. Should my experiment, and its result, possess enough of interest to entitle them to a place in the Mechanics' Magazine, you will oblige me by inserting this paper, whilst attention is directed to the subject.

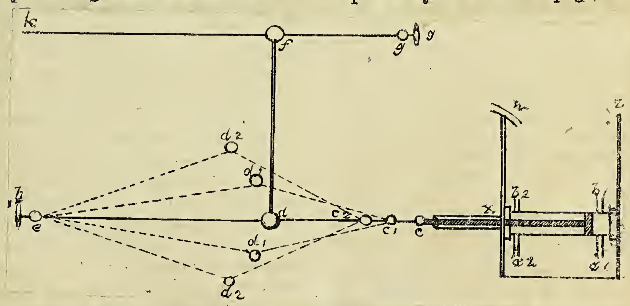
Having, in the first place, prepared a suitably strong iron stage, and an iron frame to carry a four-inch iron shaft, with a nine-inch throw carnk at its centre (the same I now have in my steam-carriage); there was, in the next place, fixed upon the centre of the stage, or platform, an ordinary double-acting steam-cylinder, 12 inches diameter, 189 stroke. An ordinary sliding valve, moved by an eccentric upon the shaft, which valve I now use to govern the ingress and egress of steam, was used, on that occasion, to regulate the ingress and egress of the water. To get over the dead points, a compensating fly, just previously patented by my engineer, was added at his suggestion: this was intended to supersede the necessity of introducing a second cylinder; the motion was, however, too slow to demonstrate the utility of that fly. After the water, which was conducted from the pump into the working cylinder by a two-inch pipe, had caused the desired motion of the piston, it escaped through a two-inch eduction pipe into the tank to perform again and again the same circulation. In the tank, which was of cast-iron, and firmly fixed upon the platform or stage, was fixed a double-acting pump on the principle of De la Hire. This pump is, I presume, so well known as to need no description. In virtue of certain arrangements for working this pump, by which it was filled four times, and emptied four times, by one revolution of its lever or handle, I hoped to obtain four times the

speed that could be divided from a single-acting pump: these arrangements were as is below stated. The pump was strongly fixed, horizontally, in the iron tank. The rod of its piston was restrained to perfect perpendicularity of action by a strong guide. In the parts which may be denominated the continuations of the piston-rod, was a joint just without the guide; at about 18 inches beyond this was another, a double joint, where was united, at right angles to the line of direction of the piston-rod, a rod from the lever or handle; and at about 20 inches farther was another joint near to the fulcrum, which was as firmly fixed as our ingenuity could contrive. When the machine was worked, by raising and depressing the lever or handle, the double-joint oscillated past the line of direction of the piston-rod. When the continuations of the piston-rod were in a right line, the piston was at the bottom of its stroke; when these continuations were at their extreme angle, the piston was at the top of its stroke. The piston of the pump was thus worked by an oblique leverage; such as is, I believe, regarded as the peculiar principle of the Russel printing-press. According to theory, the force moving the piston of the pump, is augmentable to any extent, by shortening the oscillations of the double-joint.

By thus uniting the principle of the Russel printing-press, to be worked by a common lever—that of the double-acting pump of De la Hire, made to double its celerity of motion by an arrangement of parts of its piston-rod, and that of Bramah's hydrostatic-press, to move the piston of a common double-acting steam-cylinder, so as that as little as possible of the resulting force should be neutralised by friction, I did hope to obtain an efficient power, which might be advantageously employed to propel heavily laden, slowly moving vehicles. But the experiment failed, in as much as the motion afforded was manifestly *too slow* for the purpose. When two men were working the lever, the engineer dryly remarked, "the principle throughout is good and correct, no doubt; it only wants a steam-engine to work the pump."

If—in mechanical pursuits, *if* is often a stiffly perverse monosyllable: it sometimes sticks, like a totally insuperable obstacle, right in the way of what you would do. *If* the resulting velocity had been satisfactory, the advantages contemplated were numerous. Amongst them are the following. The stock of water, costing nothing, would have circulated somewhat like the sanguineous fluid of an animal, and lasted an indefinite time. The expenses of fuel, of repair of injuries from fire, &c. &c., to which the steam-engine is liable, would have been avoided. Almost any imaginable force, at all events any force likely to be required to propel the most heavily laden carrier's waggon up the steepest roads in England, would have been obtained from the bodily strength of two or three men, simply by shortening the oscillations of the double-joint; but the machine would have crawled more slowly. When the machine was moving upon a plain road, or down a slight descent, the oscillations might have been augmented and the speed increased. Whilst descending the steepest declivity, the velocity could have been entirely governed, either restrained or the machine quite stopped, through the incompressibility of the water, at the will of the men working the lever.

Lest my verbal description of the pump used be unintelligible, I subjoin a rude sketch of its working parts. This, however, Mr. Editor, you are, of course, quite at liberty to suppress, if you consider that it is superfluous, or that it would be a waste of space in your valuable pages.



Z is the cast-iron water-tank; *y* the double-acting pump of De la Hire, strongly fixed horizontally in the tank, under water; X the guide of the piston rod; W the end of the eduction-pipe from the working cylinder, which returns the water to the tank, to be used over again; *a* 1, *a* 2, are the induction pipes of the pump, having valves opening towards the pump, or upwards. In using this pump for a common well, these

pipes may be united below the valves, so that one tube only may run down into the water ; *b* 1, *b* 2, are the eduction or force pipes of the pump, having valves opening from the pump, or upwards ; they convey the water to the working cylinder, which is not represented. In adapting this pump to domestic uses, these pipes may be united above the valves, to form one main, which may be carried to the top of the house, if required ; *c* is the first joint of the continuations of the piston rod, situated just without the guide X ; *d* is the second or double joint of the continuations of the piston rod ; at this point the rod *d f*, from the lever or handle, joins the piston rod at right angles ; *e* is the third joint of the continuations of the piston rod, situate near the fulcrum *h* ; *f* is a joint which unites the rod *df* to the lever or handle *k* ; *g* is another joint of the lever or handle, situate near its fulcrum *j*.

The fulcri *hj* being immoveably fixed, when the lever or handle *k* is raised, the double joint *d* will be moved through the point *d* 1 to *d* 2, above the line of direction of the piston rod; and when the double joint shall have attained the position of *d* 2, the piston will be drawn to the end of its stroke upwards, near the pipes *a* 2, *b* 2. By this motion the pump will be filled once, through the pipe *a* 1 ; and emptied once, through the pipe *b* 2. On depressing the handle or lever *k*, until it regain its original position, the double joint will travel through the point *d* 1, and attain its original position at *d*. The piston will be forced to the end of its stroke downwards, near the pipes *a* 1, *b* 1 ; and the pump will be discharged, for the second time, through the pipe *b* 1, and synchronously filled, for the second time, through the pipe *a* 2. On continuing the depression of the handle or lever below its present position, until the double joint *d* passes through the point *d* 1 to *d* 2, below the line of direction of the piston rod, the piston will be again drawn to the upper end of its stroke, near to the pipes *a* 2, *b* 2 ; and the pump will be discharged, for the third time, through the pipe *b* 2, and filled, for the third time, throngh the pipe *a* 1. On now raising the lever or handle until it shall have regained its original position, (when it will have completed just one revolation,) the double joint will pass through the point *d* 1, below the line of direction of the piston rod, to its original position at *d* ; and the piston will be forced again to its original position near the pipes *a* 1, *b* 1. By this motion the pump will be emptied, for the fourth time, through the pipe *b* 1 ; and filled, for the fourth time, through the pipe *a* 2. Thus by one revolution of the lever or handle, or by one oscillation of the double joint *d*, the pump will be emptied four times, and filled four times. When efficient power is to be derived from the principle of Bramah's hydrostatic-press, the expeditious filling of the working cylinder is the grand desideratum—the difficulty. In short, from the relations of the two pistons concerned, (upon which relations the power of the machine depends,) it is impossible the filling of the working cylinder can be quickly enough effected, if the power to be used is to be derived solely from the principle of the hydrostatic-press. From this circumstance arose the necessity of lessening the disproportion between the two pistons; so as, in the first place, to derive only part of the efficient force required, upon the principle of the hydrostatic-press ; and, in the next place, make up in some degree by advantageous leverage, that could be worked quickly and powerfully, to impress the first impetus upon the water. This leverage seemed attainable most easily through the principle of oblique action used in the Russel printing-press ; and if obstacles should arise, such as ascending a steep hill, greater than the primary force at command could overcome by full strokes of the piston, the resultant force might easily be augmented, by the employment of only the same primary force, by using half-strokes of the pump, by keeping the oscillations of the double joint between the points *d* 1 above and *d* 1 below the line of direction of the piston rod.

Although the combination of levers for working the pump was, I think, unexceptionable, and might be advantageously used on some occasions, still the experiment, on the whole, failed.

If there be any originality in the combination, I have no desire do reap any advantage from it by way of patent. I should, indeed, more desire to hinder any one else from so doing ; first, by offering herein the unlimited use of it to any one who may chance to see its utility and applicability ; and, secondly, by stating, that I have lately constructed another pump upon nearly the same plan. This pump, during the summer, I have had fixed half-way down in a deep well—the surface of the water being 36 feet below the surface of the earth, and I have carried the eduction pipe, or main, up to near the top of an adjoining chimney. From the main go lateral pipes, of less diameter, to coppers, sinks, dairy, &c.

This pump raised water faster than either of the cocks upon the lateral branches would deliver it, whilst subject to only the pressure of the atmosphere. The water then accumulated in the main, more or less, according to the strength and activity of the

pumper. The weight of the column of water in the main, which kept augmenting only until it reached a point now to be noticed, was adding continually its pressure to the weight of atomosphere, by which the delivery was accelerated by the cocks upon the lateral branch, turned on till it attained a point of equilibrium—a point at which the cock upon the lateral branch, although of less diameter than the main, or the barrel of the pump, delivered water just as fast the pump could raise it.

When all the cocks upon the lateral branches were turned off, the discharge up at the chimney, at the top of the main, was so profuse and forcible, that it led me to expect that, if a pump of this description were fixed in every house, and a flexible or hose pipe fitted by an union joint to the end of the main, or at some more convenient part, it might, in the case of fire in the establishment, be of considerable use as a fixed fire-engine, as well as serve the purposes of an ordinary pump for domestic uses.

KAPPA.

Sept. 21, 1835.

ELECTRO-MAGNETIC MOVING POWER.

British Association.—Section of Mathematics and General Physics.

The Rev. Mr. M'Gauley exhibited the working model of a machine for producing moving power by the application of electro-magnetic influence. The model consisted of a pendulum, the lower part of which was a magnet placed with its poles opposite to the ends of two horse-shoe bars of soft iron, round which were coiled helices of wire so arranged that by the end of the helices dipping into cups of mercury the poles of a simple galvanic battery could be alternately made to communicate with the cups in one order, and the next instant the machine reversed that order by means of a system of bent wires, caused to vibrate upon an axis, the ends of these bent wires alternately dipping into one pair of cups, and the next vibration into another; by these means the soft iron horse-shoes are at one instant a magnet, with the poles in one order, the pendulum being then attracted towards both these poles, but the next instant, the poles being reversed, the pendulum is thrown forcibly back, while the opposite soft iron horse-shoe is now a magnet ready to attract it; then again it is thrown back from this second temporary magnet by the instantaneous reversing of its poles, and so on. The model worked smoothly and with a very uniform regulated motion, and appeared to be capable of working for a great lenth of time. Mr. M'Gauley stated that the erosion of the zinc plate was so inconsiderable, that there was hardly any limit to the length of time that the model would continue working. The acid best suited to the purpose was a mixture of one part nitric acid, two parts sulphuric, and one hundred water; he also stated that the acid in practice could be always renewed by having a constant dropping of fresh acid liquor into the trough, while a similiarly gentle discharge of the spent acid from the trough could be kept up. He stated, that a numerical comparison of the economy of this mode of producing motive power with that depending upon the agency of steam, would give a vast preponderance in favour of this method, while the part of the power consumed in working the machine itself might be left entirely out of account, since the apparatus which changed the poles in his model, would equally suffice in a machine capable of working with the power of one hundred horses. In his model he only worked one of the two soft iron magnets, and its power was only that of lifting seven pounds, and yet this appeared to be sufficient to overcome all the friction, inertia, and other impediments to motion, of the several parts of the machine.

The exhibition of this model was received with sincere and reiterated applause, and many scientific men present expressed sanguine expectations of the value of the method in a practical point of view, all agreeing that it was the best attempt yet made of the many schemes that had been proposed for producing motive power by the electro-magnet.—*Athenæum.*

PAINTED BINDING.—Many beautiful subjects may be formed on the sides of books by the workman skilled in painting. The volume is prepared by being pastewashed, so as to present an uniform fawn colour, the desings slightly traced, and afterwards coloured according to the pattern, the colours being mixed to the proper shade with water. The shades must be tried on pieces of refuse leather, as, being spirit colours, when once laid on, no art can soften them down if too strong; and a peculiar lightness of touch will be necessary to produce effect. Portraits, &c., may also be executed in this manner; and many superb desings have at times been executed by the best binders of this country and France. M. Didot, booksellers, of Paris, presented a copy of the "Henriade," published by himself, to Louis XVIII., most elegantly ornamented in this style. It was executed by Mr. Bellier bookbinder, of Tours, and presented on one side a miniature portraite of Henry IV. and on the a similar one of Louis XVIII., both perfect likenesses. The greatest difficulty consisted in the portraits, which were first imprinted on paper, very moist, and immediatly applied to the cover, on which they were impressed with a flat roller. When perfectly dry, they were coloured with all the art of which the binder was capable, and the other ornamental paintings executed by hand. This proceeding requires great care in the execution; and will be applicable to any design where the binding will justify the expense.—*Arnett's Bibliopegia.*

EMBOSSING ON WOOD.

Sir,—I have been shown some very beautiful specimens of embossing upon veneer, principally floral and arabcsque designs, upon roscwood maple, mahogany, elm, and other hardwoods. The relief is almost *alto*, and has quite the appearancc of carving. I understand the invention is patented, but that the inventon; or, M. Caccia, an Italian, has been prevented from bringing it into cxtensive operation from the premarily expensive nature of the machinery, and the jealousy of cabinet-makers, who declare that it would supersede carving and enlaying, and so spoil thcir business. The process may bc so varied that the relief will be brought out in different colours; it is also applicable to the embossing of cloths, kerseymeres, waistcoat-pieces, paper-hangings, and things of a like nature.

This is the first instance, as far as I know, in which designs have been impressed upon wood—embossing is common enough upon card, paper, calico, and such fabrics; and unless there be some improvement in the process, I do not know that the patent will hold good. Making the parts in rclief come up of different colours, I believe to be new; and upon this possibly the patent rests.

Embossed hard fancy woods might be very extensively and very beautifully applied to the ornamenting of cabinets, work boxes, &c., and to the panels of doors and wainscoting. Herewith I send you some specimens that, in the effect produced, you may judge for yourself.

I am, &c.

P. B. T.

November, 1835.

[The above-mentioned specimens may be seen at our office, by any party who may think the subject worthy attention.—Ed. M. M.]

STEAM-PLOUGH.—At a meeting of the Grantham Agriculture Association, Mr. Hanley stated that he had seen a steam-plough at work in Lancashire, which did its work remarkably well, and turned up an acre of wet land, at a depth of nine inches, in 1 hour and 50 minutes.

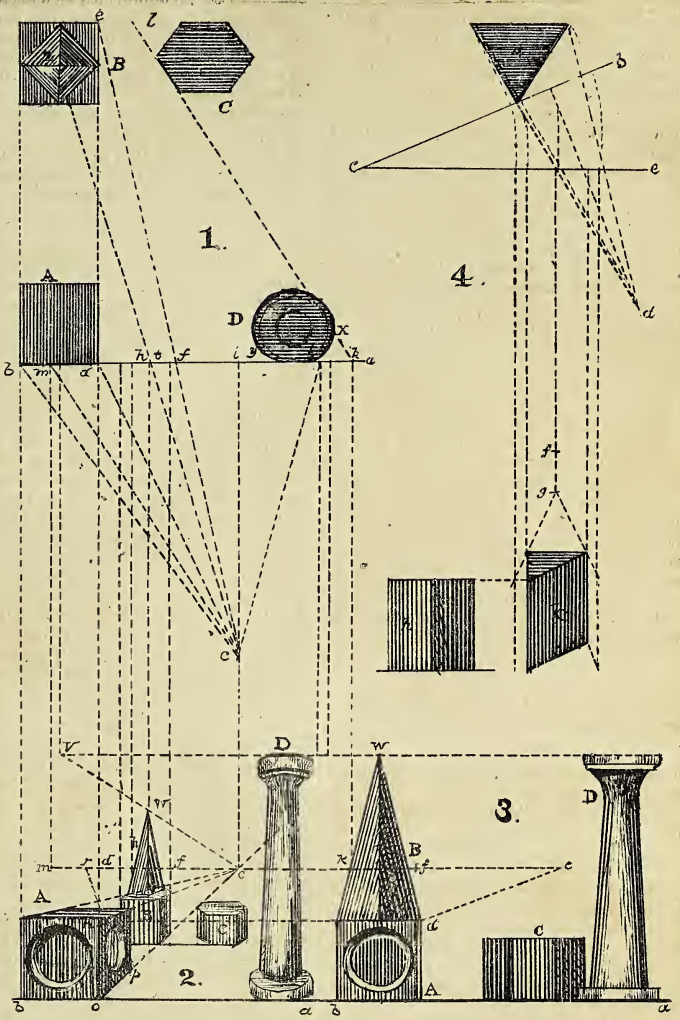
SUGAR FROM INDIAN CORN.—M. Pallas lately presented to the Academie des Sciences of Paris a sample of this substance, extracted from the stem of the plant, which has been found to contain nearly 6 per cent. of sirop boiled to 40 degrees, a part of which will not crystallize before fructification; but it condenses and acquires more consistency from that period to the state of complete maturity. The most favourable time to obtain the greatest quantity of sugar, is immediately after the maturity and gathering of the fruit. The matter left after the extraction of the sugar, is capital to feed cattle or to make packing paper.

AN AIR VIOLIN.—A newly and ingeniously invented instrument has latcly been presented to the Acadimie des Sciences of Paris, by M. Isoard It resembles the common violin, with thc strings extended between two wooden or metal bladcs; it is vibrated upon at one end by a current of air, while at the other the player presses on them, shortening them by the pression of the finger. In fact, the strings of this instrument are acted upon by a current of air, instead of the common bow. The sounds vary between those of the French horn and the bassoon.

A HAND WATER-ENGINE.—A hand water-engine, on an entirely new principle, has lately been invented by Mr. Read, the patentee of the best of all our garden syringes. This new invention is very little larger than the syringe, but it has a tube added to it, which, being inserted in a pot or bucket full of water, gives the instrument all the powers of a garden-enginc, with less than half the exertion required for working the latter machine. The power gained is by the condensation of air in a tube or barrel, parallel to that in which the piston works; so that the invention might not unjustly be called Read's double-barrelled syringe. The whole instrument, including the length of the handle, and the tube, which can be screwcd on and off, is only three feet long, and the barrel part is but half that length. The price is only 50*s*. We have seen it at work, and consider that, for all ordinary purposes, it will supersede both the garden-syringe and the Garden-engines.—*Gardener's Magazine.*

THE MOON INHABITED.—Professor Gruithausen, of Munich, has publicly declared that he has discovered irrefragable proofs that the moon is inhabited like the earth. All Europe has answered by railleries the declaration of the Bavarian astronomer, but his firmness has been no more shaken than that of Christopher Columbus was, when he announced the existence of a new world. The German Journals have published the observations of Professor Gruithausen, combined with those of his learned brother, the astronomer Schroeler. Their common conclusions are, 1st, that vegetation upon the surface of the moon extends to the 55th degree of latitude south, and to the 65th degree of latitude north; 2dly, that from the 50th degree of latitude north to the 47th degree of latitude south, may be perceivcd evident traces of the abode of animated beings; 3dly, that some signs of the existence of lunar inhabitants are sufficiently apparent to enable a person to distinguish great roads traced in several directions, and particularly a colossal building situated nearly under the equator of the planet. The *ensemble* presents the aspect of a large town near to which may be distinguished a building, perfeetly resembling that which we call a redoubt, or horn work.—[Query—Are there any mines or railways?—Ed. *Mining Journal.*

PERSPECTIVE MADE EASY.



Sir,—The following paper on *Perspective Drawing* is intended to be useful to those readers of your Magazine who want information on that subject, and who are not mathematicians enough to understand the ordinary treatises. By giving it a place in the Mechanics' Magazine, you will very much oblige,

Yours truly,

JAMES WHITELAW.

Glasgow, July 27, 1835.

1. If a person behind a transparent plane kept his eye exactly in the same position till he traced on the plane the objects on the other side of it, by means of a pencil carried over the parts of the plane, where the rays of light reflected to the eye from all the lines in the objects cut the plane, the delineation would be a perspective drawing of the objects.

2. Fig. 1 is a ground plan of a number of objects, marked A B C D, standing on a

horizontal surface : these same letters in fig. 3 point out the same objects in elevation ; and fig. 2 is a perspective view of them.

3. In order to draw the perspective view, make first the ground plan and elevation, as in figs. 1 and 3, then draw a line *a b* in fig. 1, to represent the transparent plane, which stands perpendicular to the surface on which the objects A B, &c. stand ; and after this, fix upon the point *c*, in the same fig, for the position of the eye. But before making a full view, it may be as well to illustrate the method, by finding the perspective of the line *d e*, in fig. 1, which stands perpendicular to the transparent plane. The point *f*, which marks the position of *d e*, in the elevation. is on a level with the eye. From the ends of the line *d e*, draw the lines *d c* and *e c* to *c*, the point of sight; and the part *f d* of the transparent plane or picture-sheet contained between the lines *d c* and *e c*, will be the perspective in the ground plan of the line *d e*, because the lines *d c* and *e c* represent the rays of light reflected to the eye from the ends of the line *d e*. From what is now said, it will be evident that *f h* shows the perspective in the ground plan of the part *e g* of the line *d e*, and that *h d* is the perspective in the same plan of *g d*, the other part of *d e*. If a line is drawn through *c*, parallel to *d e*, till it meets the picture-sheet in *i*, *r d* will show, in fig. 1, the perspective of the line *d e*, if it is indefinitely extended in the direction *d e*. For by inspecting the ground plan, it will be seen that the more distant from the picture sheet any point *e* is taken, the line drawn to the eye from that point becomes more nearly parallel to *c i*, and in consequence of this, *i f* becomes smaller the more distant the point is taken. Although we cannot name a distance from the picture-sheet for the position of the point *e* that will make *i* and *f* exactly coincide, yet we can place *e* so distant, that the space betwixt *i* and *f* will be smallar than any quantity that we can form a notion of, and for this reason *i d* must be considered the perspective in the ground plan of the line *d e*, when it is indefinitely extended from the point *d* in the picture-sheet, or from the point *f* in the elevation on a level with *c*, the point of sight in the same view.

4. We now know how to represent on an edge view of the transparent plane or picture-sheet, the perspective of any line or part of a line running perpendicular to the transparent plane on the same level with the eye ; but in order to make a picture, the perspectives of the lines in the objects to be represented must be shown, not on an edge, but on an elevation of the picture-sheet. Let fig. 2 be this elevation, and in this fig. drawn the line *a b*, which is just a continuation of *a b* in fig. 3, the line representing the surface on which the objects stand ; then draw a line perpendicular to *a b*, in the perspective view, from the point *c*, in fig. 1, and a horizontal line *c m* from *c*, which marks the position of the eye in the elevation, and the point *c*, in fig.2, where these lines meet, is the position of the eye in the perspective view. The points *c* and *i* in the ground plan coincide in the perspective view, as the line *d e* stands perpendicular to the picture sheet in the side as well as in the up and down direction. And as this line *d e* has its commencement at the picture-sheet on a level with the eye, if lines are let fall from the points *d h* and *f*, in the ground plan, perpendicular to the line *a b*, in the perspective view, these perpendicular lines will cut the horizontal line *c m*, in fig. 2., in the points *d h* and *f*, and these points will be the perspectives of the points marked *d*, *g*, and *e*, respectively, in the ground plan. If the points *d* and *f*, in fig. 2, are joined, the line *d f*, will be the perspective of the line *d e* ; the part *d e* of this perspective line, is the perspective of *d g*, part of *d e*, and a line joining the points *d* and *c*, in fig. 2, is the perspective of the line *d e* in the ground plan, when it is indefinitely extended in the direction *d e*.

5. Let the line *d e*, fig. 1, have its commencement in the elevation at *d*, one of the corners of the cube A ; its perspective view is found as follows :—From the point *d*, in fig. 1, draw a line *d o*, perpendicular to the line *a b*, in the perspective view ; and from *d*, fig. 3, draw a line *d n*, parallel to *a b* in fig. 2, and the point *n*, where the line *d n* cuts the line *d o*, is the commencement of the perspective of the line *d e* ; join *n c*, and this line will be the perspective of the line *d e*, when it is indefinitely extended. A line joining the points *o* and *c* is the perspective of the line *d e*, if it is indefinitely extended when it has its position in the elevation at the corner of the cube under *d*. The point *o*, where the perspective line *o c* commences, is found in the very same way as the point *n* was found. As *n c* is the perspective of *d e*, when it is indefinitely extended from *d*, in fig. 3, one of the top corners of the cube A ; and as *o c* is the perspective of *d e*, when it is indefinitely extended from the corner under *d* of the cube A in fig. 3, the triangle *n c o* is the perspective of a parallel surface, standing perpendicular to the surface on which the objects A, B, &c. stand, and running at right angles to the picture-sheet to an indefinite distance from it. The side of the cube A, that is, towards the centre of the picture,

and the same side of the cube under the pyramid, form part of the perspective of this parallel surface. The point b, where the line hp, let fall from point h in the ground plan, perpendicular to the line $a\,b$ in the perspective view, cuts the line $o\,c$, is the perspective of the bottom corner at g, of the cube A; and the place where this same line $h\,p$ cuts the perspective line $n\,c$, is the perspective of the top corner g, of the cube marked A, in fig. 1. So now we have got the perspectives of the four corners of one of the sides of the cube in front of the picture. and by joining these corners we get the surface np, and this surface is the perspective of the side of this cube, that is, towards the object D. A perpendicular, let fall upon the line $a\,b$, in fig. 2, from the point f, in the ground plane will cut the lines $n\,c$ and $o\,c$, so as to give the perspectives of the top and bottom corners at e of the cube under the pyramid; and the other two corners of the side of this cube, that is, next the object C, is obtained in a similar manner. The manner of demonstrating what has been said in this paragraph about the perspectives of lines running perpendicular to the picture-sheet, from any point in it, to an indefinite distance from their commencement, is shown in paragraphs 3 and 4. Before proceeding farther, it may be as well to turn over and read remarks 2, 4, and 6.

6. We now know how to find the perspective of any point in a line that stands perpendicular to the transparent plane; but if the perspective of a point, which is not in a line so situated, be wanted, we can draw a line perpendicular to the picture-sheet through the point, (or suppose a line so drawn,) and find the perspective of the point, as if it had its place in this line. The following *rule to find the perspective of any point in an object*, rests upon this principle. When the perspectives of all the points in an object are found, the perspective drawing of the object is completed by joining these perspective points.

To be continued

ON CALICO-PRINTING.

By Thomas Thomson, M. D., F. R. S. L. and E. &c. &c.

Regius Professor of Chemistry in the University of Glasgow.

(*Continued from page* 104.)

2. MADDER PURPLE.—The iron mordant thickened in the same way as the alum mordant, is similarly applied. The cloth is then exposed to the air for a few days, and the iron fixes itself on the cloth in proportion as it becomes peroxidized. The piece is then cleaned and washed as described in the last process, dyed in madder, and cleared in the same way as in the red just described. The depth of the purple depends upon the strength of the iron mordant. If its specific gravity be as high as 1·04, it forms a black, as appears in the three succeeding specimens.

3. This piece shows two different shades of purple, or rather black and purple along with red, all dyed at once. The black and purple are printed together by the cylinder machine, with two copper rollers, and the purple is printed afterwards by the block.

4. COCHINEAL PINK.—After the black in this pattern has been produced in the way already detailed, it receives an alum mordant on those parts which are intended to become pink. It is then cleansed and dyed in cochineal in a similar way as when cloth is dyed with madder. The cochineal does not tinge the ground as madder does; and therefore, does not require, nor is it of sufficient permanence to bear the same clearing operations. So much colouring matter does the cochineal insect contain, that one ounce is sufficient to dye fifteen or twenty yards of such a pattern, as No. 4.

5. LOGWOOD BLACK.—The same alum mordant which forms a red with madder, becomes black when dyed with logwood. The iron mordant has the same property; but it forms a brownish, and less pleasing colour. Rincing the piece of goods in hot bran and water, is sufficient to remove the tinge of logwood from the white ground.

6. The two shades of colour in No. 6, are obtained from mixed alum and iron mordants, dyed in a mixture of madder and quercitron bark. The mode of producing the black and white figures on it, will be explained afterwards.

7. PRUSSIAN BLUE.—The iron mordant is applied, and the cloth cleansed in the way already described. It is converted into Prussian blue of various hues, by immersion in cold prussic acid. This acid is liberated from a weak solution of prussiate of potash, by an equivalent of sulphuric acid. A more convenient process for this colour, is now employed, and it will be explained, when we come to speak of steam colours.

8. BUFF FROM IRON.—This pleasing colour is merely the peroxide of iron. A mixture of sulphate of iron and acetate of lead is printed on the cloth, constituting in fact, sulphate and acetate of iron together. After exposure to the air for a considerable time, to produce as large a deposit as possible upon the cloth, the iron is farther precipitated by immersing the piece in thick lime water, or in a mixture of caustic potash and lime. A portion of black oxide is thus thrown down along with the red, which speedily changes in the fresh water and air to which it is afterwards exposed.

9. MANGANESE BRONZE.—A solution of sulphate of manganese is printed on the cloth by the copper roller. When dry,

the piece is passed through a strong caustic alkali, and then allowed to fall into a vessel containing chloride of lime. This converts the manganese into sesquioxide, which has a strong affinity for cotton.

10. CHINA BLUE.—Indigo may be fixed upon cotton in a variety of ways. By having it with orpiment and caustic potash, it is deoxidized and dissolved. If gum-senegal or basted starch be not dissolved in the solution, it forms what is called *pencil blue*, which may be printed upon cloth by means of the copper roller, or by the block from a sieve of a peculiar kind. Applied in either of these ways, the indigo soon recovers its blue colour, and being no longer soluble, it remains upon the cloth, while water removes the substances with which it was mixed.

By another process, indigo in the blue state is mixed with orpiment in a solution of sulphate of iron, and deoxidized after being printed on the cloth, by alternate immersions in lime and copperas. It is known that indigo in the doxidized or white state, is soluble in alkalies, forming a yellow coloured solution. This solution deposits its deoxidized indigo on the cloth by mere contact. In this way the indigo which is at first loosely laid upon the fibres, and easily removeable by washing, is slowly combined with them, and thus becomes fixed on the cloth. A large quantity of iron is necessarily attached to the cloth during this process, and a continued action of sulphuric acid is necessary for its removal.

A third process consists in dissolving powdered indigo in a hot solution of potash, and stannite of potash, or by boiling it in potash or soda, along with metallic tin. It is then precipitated in a white state by muriatic acid, and the precipitate being thickened and mixed with fresh chloride of tin, is printed on the cloth. When dry, the piece is immersed in a solution of carbonate of soda. The indigo becomes yellow by combining with the soda, and in this soluble condition, attaches itself permanently to the cloth. It soon afterwards becomes blue, by the absorption of oxygen from the atmosphere.

11. CATECHU BROWN.—This important dy-stuff, formerly known by the name of *terra japonica*, is procured by boiling the brown heart wood of the acacia catechu, or khair-tree. It is obtained by simply boiling the chips in water, until the inspissated juice has acquired a proper consistency. The liquor is then strained, and soon coagulates into a mass. It comes to this country both from Bombay and Bengal. It consists chiefly of tannin, but contains also a little alumina, which may perhaps assist in fixing the colour on the cloth.

The catechu is dissolved in acetic acid; a solution of copper and salammoniac is added to it, and the whole printed on the cloth. It is allowed to stand a few days, during which the colour deepens very much, and is then worked off.

CHROME ORANGE.—The dichromate of lead is precipitated upon the surface of cotton cloth, by printing on it a solution of lead, and then immersing the cloth in a hot solution of a chromic salt of potash, or of lime, containing a slight excess of base; or, it is sometimes obtained from the yellow chromate of lead, produced from the bichromate of potash, by abstracting a portion of its acid in hot lime-water.

To be continued.

ON MALT.

By Rorbet D. Thomson, M. D.

(*Continued from pages* 99.)

Bigg and *bear* are susceptible of exposure to greater vicissitudes of climate than barley is. They require also less time to attain to maturity. Thus, the average time in which they usually remain in the ground is from ten to fourteen weeks; while barley lies from fourteen to twenty weeks. An instance is recorded where the interval between seed time and harvest, in the cases of *bear*, was only nine weeks; and another, on the contrary, where barley was twenty-six weeks of ripening. Bear and bigg in common years are malted by the Highlanders, but in those seasons which are unpropitious for the ripening of oats, they form the chief article of food. Hence, the legislature have been induced to charge a duty of 2s. 7d. per bushel on malted barley, and 2s. only on malted bear and bigg. In 1789 and 1799, which were late years, the whole of the barley sown in Aberdeenshire was destroyed, a circumstance which operated so powerfully upon the farmers, that in 1803, little, more than 100 quarters were raised, while from 35,000 to 50,000 quarters of bear and bigg were produced.

Now, Aberdeenshire consists of 832,000 English acres and possesses a mean temperature of 41°.14.

Mr. Forbes Royle observed barley growing on the Himalah mountains, at an elevation of 8000 feet, the mean temperature of the place being 55° F. But some very important deductions have been obtained by M. M. Edwards and Colin,* from their interesting experiments upon the germination of different kinds of grain. They exposed barley, wheat and rye to a cold equal to that at which mercury freezes or—38·6° F. for 15 minutes, and found that their vegetative powers were not in the least deteriorated. They ascertained that if barley, wheat, French beans or linseed were immersed for a quarter of an hour in water at the temperature of 154°, the power of germination was completely destroyed, and it was not till the heat of the water was reduced to 122°, that these kinds of grain after being immersed in it would vegetate. Hence, in water, 122° may be considered the highest limit at which it is possible for barley to grow. But the temperature varies according to the media through which the heat is communicated. Thus these seeds if exposed to a temperature above 143½° in vapour, or 167° in dry air, are deprived of their vegetating properties. While wheat, barley, oats and rye, when kept in hot sand possessing a heat of 113°, would not ger-

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* Ann. de Scien. Nat. for May, 1836.

minate. Immersion in water of the temperature of 167° for 15 seconds was sufficient to destroy the power of germination in most instances; but this invariably occurred, if the exposure to this high temperature was protracted for 5 minutes. The method in which the heat operates in these cases, appears to be in some measure elucidated by the researches of Biot, Persoz, and Raspail, who observed that the temperature 167° is that at which the grains of starch burst. Hence, it appears, that in dry air barley may be exposed to a range of temperature equivalent to 205° at least, and may still retain its germinating powers unimpaired.

We have two quantitative analyses of barley, one by Einhof and the other by Proust. The following are their results. Einhof obtained from Hordeum *vulgare.*

Starch not quite free from gluten 67.187, Volatile matter 9·375, Saccharine matter 5.208, Husk with some gluten and starch 6·770, Mucilage 4·583, Gluten 3·515, Albumen 1·114, Phosphate of lime and loss 2·248

100 000*

Proust obtained Yellow resin 1· Gum 4 Sugar 5, Gluten 3, Starch 32, Hordein 55,

100·†

In these results we observe considerable differences, which are to be attributed to the mode in which the analyses were conducted.

Einhof determined the weight of the starch and gluten together, when they had been deposited from water in which the meal contained in a linen bag had been kneaded.

The water from which the starch was separated was filtered and boiled; coagulated albumen subsided, and by evaporation an extract was afforded which was treated with alcohol. It gave gluten and sugar. These substances were separated by mixing the alcoholic solution with water and distilling the alcohol. The gluten fell down, and the sugar remained dissolved in the fluid. The alcohol left undissolved some gum and phosphate of lime. The former was taken up by water and left the latter in a pure state. The matter in the linen bag consisted of vegetable fibre, mixed with a little gluten and starch. The *hordein* of Proust was obtained equally well by means of hot or cold water, which dissolved the starch and left the *hordein* in an insulated state. Raspail considers this substance to be the pericarp of the seed or what we term bran. The propriety of this opinion is strengthened by the circumstance that there is very little of it existing in pearl barley. The substances reckoned by the French chemists as constituents of starch, viz. *amidone, diatase, amidine,* and *dextrine,* there is strong reason to consider as products of the analytical operations.‡

It is a remarkable circumstance, in reference to the starch which forms such a principal constituent of the seed of barley, that it is possessed of a most durable nature when preserved in dry magazines. This fact is illustrated in a very striking point of view by some researches of the French chemists.* In 1817 a depôt of barley was discovered in the citadel of Metz, which had remained closed up from the year 1523, and notwithstanding that it had remained in this state for 294 years, it afforded excellent bread when converted into meal. A similar magazine was also recently detected in some villages destroyed by the Turks in 1526, where the corn appeared to have lost none of its qualities proper for forming an essential article of food.

These though remarkable instances of the capacity which the starch of barley possesses of withstanding decomposition, must yield infinitely in importance to observations which have been made upon grain preserved in the collections of M. Passalacqua. That gentleman brought from the ruins of Thebes, in Egypt, some grain, which, when examined by D'Arcet, Vauquelin, Bailly, and Fontennelle, was found to be slightly acid, and to contain its proper quantity of starch, but no gluten. Raspail subsequently confirmed the accuracy of these chemists. When Passalacqua sold his collection of antiquities to the king of Prussia, Champolion found between the limbs of a mummy which he recognised as the remains of Pharoah, son of Marsaroun Mainoute, or priest of a great tribe, attached to the worship of the goddess Netpha, the Egyptain Rhea mother of Osiris and Isis,) a small brown compact loaf, surrounding a number of grains of barley, which had germinated and been slightly scorched. These seeds, which must have been above 3000 years old, were examined by M. Julia Fontennelle, who could detect no gluten in them, but found that the starch, by its action on iodine, was not impaired in its properties, A little acid was also present, as was demonstrated by the reaction on.

When exposed to the air and moisture, however, starch undergoes a remarkable change. M. Lassaigne examined some wheat which was found in pulling down a house in Paris, at the Quai de la Greve. It possessed a black colour, as if it had been converted into charcoal. It contained neither starch nor gluten, but much *ulmine or ulmic acid.* The appearance of the grain led this chemist to believe that it had been partially converted into coal, in a manner similar to that in which trees and smaller vegetables have been changed into coal, jet, and peat. Wheat found at Royat, near Clemont, (Auvergne) in the mountain called the Granaries of Cæsar, M. Lassaigne ascertained had undergone a similar change.

The precise researches of Raspail enable us to comprehend in some measure the cause of this stability in the nature of starch. According to him, starch consists of grains which vary in form and dimensions, the diameters not exceeding, in maturity, ·00393 inch; but before they have attained their full size, being exceedingly more minute. Those of the Hordium *vulgare* are about ·0098 inch in diameter.

* Gmlen, vi. 83. Thomson's Chemistry, iv. 262.
† Ann. of Phil. xiii 201.
‡ Records of General Science, i. 196.

* Journ. de Chim. medicale, i. 63, 2nd. ser.

In each grain, when viewed under the microscope, the rays of light are strongly deviated at their entry and departure, so that only those reach the eye which pass through the interior of the globule, and hence, they appear as black balls with a white nucleus. They consist of vesicles, filled with a gummy matter, which hardens in contact with air. In water of the temperature 122º the bladder is expanded, probably by the increase in volume of the gum. In boiling water it is ruptured and precipitated, while the gum (the *dextrine* of Biot) dissolves in the water. Iodine colours the grains not by combining with them, but by merely attaching itself to the exterior of the visicles. The form of the grain is not altered; for, if inorganic salts capable of combining with the iodine, and forming hydriodates, are mixed with the starch, the colour disappears, and the starch remains colourless.*

The nature of the *diates* which Payen and Persoz have found in starch, Raspail explains in this way: In the act of germination the grains of which starch consists increase by successive layers, beginning nearest the cotyledon, while at the same time acetic acid is formed; now this acid is formed; now this acid dissolves gluten, and renders it equally soluble in water and alcohol. If the flour of germinating barley be macerated for an hour in pure water, the water will dissolve the gum, sugar, and gluten combined with the acetic acid. When exposed to heat a flocky precipitate will be produced by the disengagement of a portion of the acetic acid by heat, or of its saturation by some base, disengaged from the tissue by the temperature. Alcohol will increase the quantity of the precipitate. Raspail digested for a few minutes some wheat flour in acetic acid, at first concentrated, and then diluted with a hundred times its weight in water. It was filtered, and the liquid poured into a solution of starch. A precipitation of the tegumentary matter immediately ensued.

These facts are extremely important when considered in connexion with the process of malting, because they exhibit in a powerful manner the greatness of the change which is produced by the slightest effort of Nature's operations, and because they enable us to comprehend more readily the variety of alterations which the elements of grain undergo in the same process.

The process of malting consists essentially, 1*st*., in producing a change in the constituents of grain by inducing germination; and 2*nd*. in stopping the vegetation when it has been carried to a certain extent, by exposure to heat.

RECENT AMERICAN PATENTS.

(Selected from the Franklin Jaurnal for May, June and July last.)

IMPROVED SUCTION PUMP, ELIJAH WHITON, MASSACHUSETTS.—The barrels are to be made of steatite or soap stone; but the principal novelty is a contrivance for opening both the valves, and allowing the water to descend to prevent its freezing. There is to be a sort of spring catch on the upper surface of the valve of the lower box, which, when the pump handle is raised to the greatest possible height, hooks on to a ring, or other suitable appendage, on the lower end of the piston, whilst, at the same time, a projecting pin opens the valve in the piston, or bucket, and the water necessarily descends into the well, or reservoir.

STRAW CUTTER, STEPHEN USTICK, PHILADELPHIA.—There is, we think, considerable novelty in certain parts of this machine, but it has the fault of too much complexity. The straw is to be contained in a trough, in the usual way, and is to be fed by fluted rollers of cast-iron. The knife stands horizontally, or nearly so, across a frame to which it is firmly attached. The lower edge of this frame rests upon ways, which from an inclined plane, and, consequently, as the frame slides, the knife descends with a drawing notion. To cause the frame to slide backwards and forwards, there is a pitman, worked by a crank, on the shaft of a fly wheel in front of the machine.

PRESERVING TIMBER FROM DECAY, FORREST SHEPHERD, FREDERICKSBURG.—The wood is first to be steamed, or boiled, to "destroy the sap, or principle of decay," and after this to be immersed in pyroligneous acid, until saturated. The patentee says that he also preserves wood from decay, and from destruction by worms, by boiling it in a solution of sulphate of iron, sulphate of alumine, and muriate of soda; or, in other words, in a solution of copperas, alum, and common salt, taking half an ounce of each to a gallon of water.

We apprehend that the foregoing directions are altogether empirical, and that the patentee has been guided more by his hopes than by his experience, which ought, in such a case, to be the result of long continued and varied observation. A patent was lately obtained for saturating timber with lime, which was to neutralize the acid supposed to be contained in it; in the present instance, it is to be made to imbibe as much acid as possible; these views are theoretical, or rather hypothetical, and must not be depended upon as guides. The present patentee's specification makes no claim, offers little or nothing that is new, and merely lays before us several recipes, from which to make a choice. The saline solutions named will do much towards rendering the wood incombustible, if they do not protect it against the attacks of the dry rot.

HORSE-SHOE-MAKING MACHINE, E. E. RARRE, AND S. FIELD, OAKHAM.—In the lower part of a very stout orame of cast-iron, a horizontal spindle is to fun, in the manner of a lathe mandrel; one end of this spindle is to project through a collar, and to carry a kind of chuck, the face of which is to be grooved, so as to form a mould, into which the heated iron is to be forced in order to convert it into shoes. This moulding face is

† Nouveau Systeme de Chimie organique fonde sur des methodes nouvelles d'observation par F. V. Raspail, 8vo, 1833, p. 3, 562.

to be about sixteen inches in diameter, and the groove about two inches clear of its edge. When horse-shoes are to be formed, the indentations for two of them are contained in the circle, two cutters, or chisels, being placed in it to divide the iron; for ox shoes, four such cutters are used. There are to be creasing dies, corresponding with the number of shoes, on which are raised as many projections as there are nails to be employed. A punch, or punches, operated upon by cams, and passing through the moulder are to throw the shoes out of the groove.

In order to force the iron into the moulding-groove, there is a roller revolving vertically, the lower end of which roller projects through a collar, and bears against the face of the moulder. The heated bar is to be passed through an opening, or notch, which guides it between the roller and the groove, by which it is to receive its form.

We do not see in this machinery any thing calculated to remove the difficulties which have been hitherto encountered in the attempts to make horse-shoes by rolling. There has in every instance, we believe, been a considerable waste of metal, and fins have been left upon the edges, which not only increase the waste, but are difficult to remove; and, after all, the horse-shoe is not completed by the machine, but has to undergo considerable forging to prepare it for use. We predict, therefore, that it will prove a total failure.

RECENT AMERICAN PATENTS.

(Selected from the Franklin Journal for August.)

GUM ELASTIC SHEATHING FOR VESSELS AND BUILDINGS, GEORGE D. COOPER, NEW YORK.—The caoutchouc or gum elastic is to be used "to prevent vessels and buildings from leaking, and to preserve the crews of vessels from the effects of dampness caused by the salting of vessels." We are told to take the material and to "divide it and run it into sheets one quarter of an inch thick, and of such length and width as the owner or builder may select, or else to import the sheets ready cast from Para, the place where the gum elastic is produced." These directions are more easily given than followed, and it would have been very satisfactory to have been told how to "run into sheets" of the desired length, breadth, and thickness, without impairing its quaility. To get such sheets made by the persons, and in the places, where the gum elastic is produced, would be no easy task; we, however, will suppose this to be done, or the India rubber cloth which is prepared in this country, by covering canvass on one or both sides with that material, to be substituted, therefore, agreeably to the directions of the patentee; this material is to be applied "between the inner part of the ribs, and the inner planking; between the outer part of the ribs, and the outward planking; between the outward blanking of the copper and between the deck beams and the cleep planking." Particular directions are given for laying it on, which, we need not repeat. In covering houses, the sheets are first to be laid upon rough planks, uniting their edges by dissolved gum elastic, and then shingling, or slating, over thewhole, "so that the roof, &c. is not only water-tight, but air-tight." There is no claim made, but the thing intended to be secured by Letters Patent, is the interposing the gum elastic between the sheathing and other parts of vessels and between the boards and outward covering of roofs. It may, no doubt, be very advantageously applied to some of the purposes designated, but in others the test of experience can alone determine its utility. Under shingles, for example, the retaining of the water may tend to rot them very rapidly; and it is not imposible that the agents to which it will be subjected when used under water, may operate upon it disadvantageously; it, however, is well worih the trial.

SELF-OPERATING INK DISTRIBUTER, JOHN MAXSON, SCHENECTADY.—Various machines have been patented for the purpose of inking the form in the common handpress, without the aid of a second person; but, after a fair trial, they have generally been abandoned, as they are liable to get out of order, and do not execute the work as uniformly as by a roller-body. The machine before us is spoken of as though it had no predecessor, and the end to be attained, as though it had previously been unattempted, which, as we have already intimated, ls incorrect. Considerable ingenuity is manifested in the plan before us, and the machine is sufficiently novel in its construction to maintain its claim to a patent, but we do not see in it any thing calculated to obviate the objection which experience has shown to exist against those which have been tried. To describe it without the drawing would be difficult, and would interest but few of our readers.

RAILWAY PHENOMENON.—On Monday last a gentleman in this town, who had taken his place in the hindmost carriage of one of the railway trains from Bolton to Kenyon, witnessed the following singular occurrence:—He was placed with his back to the engine, and had a clear view of the receding line of railway. The train was going down the inclined plane from Bag-lane to Leigh, at the apparent rate of from 30 to 40 miles per hour. A man who was standing on the side of the railway threw a stone about the

size of a hen's egg in a horizontal direction, and with considerable violence, at the train. The stone was distinctly seen by the gentleman in its progress to the carriage in which he was seated, and, having attained its maximum of velocity, it appeared, like Mahomet's coffin, to be suspended in the air for a few seconds within a foot of the gentleman's head. He seized hold of it, and he describes the sensation which he felt in doing so as somewhat similar to that which would be felt in grasping a stone, in a state of rest, suspended by a thread.—*Bolton, Chronicle.*—[This is easily accounted for; both the train and the stone had attained the same velocity.] —*Manchester Advertiser.*

NEW HYDROSTATIC ENGINE.—We have had an opportunity of examining the recent discovery made by the Rev. J. T. Porter, of the 'Close of this city, which he had named an hydrostatic-engine, and which, when brought to perfection, will in all probability, vie with the astonishing power of steam. The principle upon which the engine acts is the well-known law of nature, "the pressure of fluids." The construction of the apparatus is simple, consisting of four cylinders, two of which act as pumps the other two as working cylinders, each of them having proper pistons. The double-acting power (of the model) is put in motion by only 25 ounces of water, assisted by the lever. Some idea may be formed of the force of the pressure, when we say that with the stroke of one of the cylinders of the piston, an ash bough, an inch and a half in diameter, was broken with the greatest ease. The rev. gentleman is verg sanguine as to the ultimate success of his discovery, and affirms that a ship, laden with the usual freight, may take a trip to the East Indies and back, the engine requiring for its total supply not more than a half hogshead of spring-water.—*Salisbury Journal.*

EXTRA LIMITES.
TOPOGRAPHY OF INDIA.

COMPILED FROM VARIOUS WORKS AND MANUSCRIPTS

BY THE EDITOR

THE TOPOGRAPHY OF ARRACAN

It is difficult to please every class of our readers, and being apprehensive that the historical portion of our Topography may be deemed irrelevant to a Medical Journal, we shall give this portion of our labours to the Scientific Journal, and that which relates to climate, situation, diseases, &c. to the Medical.

ARRACAN.

(Continued from page 334.)

In their entertainments they have plenty of provisions: but then they are such as are neither pleasing to the eye nor taste. They mix with their choicest dishes the flesh of rats, mice, serpents, and other loathsome animals. They never eat fish till it is in a state of corruption, thinking it has the best relish when it stinks the most. They take of this putrid fish, after it has been dried in the sun, and, beating it into a consistency, make a kind of mustard of it, which they call *sidol*; and this they strew over all their victuals. The better sort make use of the flesh of crabs, mixt with other ingredients: which not being so rotton as the other fish, is somewhat less intolerable. They serve up their meat in small dishes, one hundred or two at a time, that every body may meet with what he likes. Instead of bread they use rice, both parched and bruised, or otherwise ordered in the flour * Their usual drink is water, or a liquor called *auze*, which is the juice of a tree much like the palm: and taken from it by incision, in the same manner as in the other peninsula of *India**.

The people of *Arrakan* have an aversion to appear moral even which they look on as something low; and therefore hire the *Dutch* sailors, or any strangers, to be quilty of every indecency with their females.

The courtship begins by little presents and interviews; and when matters are concluded, the parties confirm their engagements before the idol, in presence of their parents: the *Talipoin* (or priest), of whose sect they are, performing certain ceremonies besides. On these occasions there are presents made of precious stones to the bride: fire-works and feasts are prepared, accompanied with music and dancing. The men are allowed

* Ovingt. ubi supr.

* Schouten, p. 231.

several wives; they may likewise keep concubines, and public dancers*.

When any fall sick, the physician is sent for; but the *Raulîn*, or priest, is the person on whom they most depend for a cure. They first blow their breath on them, repeating certain prayers; and if this does not do, they tell the patient that he must offer a sacrifice to *Chaor Baos*, that is the god of the four winds, who, they say, is the author of all distempers. This sacrifice, called *Kalouko*, consists of fowls, hogs, and other animals; and must be repeated four times, to every wind distinctly, in case he does not recover time enough to prevent the expence. On these sacrifices the priests feast themselves. But if, after this, the distemper proves obstinate, then the wife, or nearest relation, must make a vow to perform another piece of priestcraft, called a *Talagno* To this purpose a chamber must be hanged with rich tapestry, and an idol placed upon an altar raised at one end of it; when all things are made ready, on the day appointed, the priests, with the sick person's relations, repair thither, and are feasted for eight days together.

To complete the farce, the person who makes the vow is obliged to dance as long as he is able to stand; and when his legs will support him no longer, he must take hold of a piece of cloth fastened to a beam, and continue dancing till he has quite exhausted his spirits, and drops down on the spot. Then the music is redoubled, and the spectators, who are as great fools as the vow-maker, envy his happiness; supposing him all the while he lies in this condition to converse with the Idol. This exercise he is obliged to repeat every day as long as the feasting lasts; but if he has not strength to go through it, some near relation is to dance in his place. In case, after the *Talagno* is completed, the patient happens to recover, he is carried to the pagoda, where he is anointed with perfumed oils from head to foot: but if, on the contrary, he dies, the priest tells his relations, that the sacrifices were well accepted by the gods; and that the reason why they did not grant him a longer life was, because they designed him a greater favour, by taking him to themselves.

Their funerals are no less superstitious, and, consequently ridiculous: for the corpse being brought into the middle of the house, the *Raulîn* walks round it, and says over it certain prayers, whilst others perfume the place with incense; and the family beat upon a broad piece of brass, keeping strict watch at the same time, lest a *black cat* should pass over him: for in that case he would be constrained to return to life again with ignominy, and be deprived of bliss. Before the body is carried out of the house, they invite to a banquet a sort of people called *Graü*, whose refusal causes dreadful lamentation among his relations; as taking it for an infallible sign that his soul is condemned to *the house of smoke*, so they call hell. The coffin is adorned according to the ability of the people: and, as they hold the *metempsychôsis*, they paint on it the figures of horses, elephants, eagles, cows, lions, and the like noble animals, as it were to direct the departed soul to the best lodging; unless, out of humility, the deceased had ordered rats, frogs, and the most contemptible creatures, to be drawn in their stead, as more suitable receptacles for his polluted soul. After this, the body is carried into the field, and burnt to ashes. The *Raulîn* kindles the fire, which the relations attend, clad in white; which is their mourning colour, only they wear a black band round their head*.

At their funerals they have always hired mourners, who attend sometimes all night as well as day, and pretend much sorrow. They who cannot afford wood to burn the corpse, for it is very dear in this country, carry it to the river at low water, and leave it for the next tide to carry it off: but as the dead carcases often remain in the river, either sunk or floating, it gives an ill taste to the water. This also fills the country with ravens, kites, and other birds of prey, which not only feed on these corpses, but attack the buffaloes, and other horned cattle; fixing on their backs, and tearing off the flesh to the very bones, in spite of all their efforts to shake them off. The natives not only carry the dead bodies to rivers, but also expose the living in the same manner, when afflicted with grievous diseases, which they judge to be incurable; so that if the water does not carry them clear away, they are sure to be drowned. This they call humanity, charity, and compassion for the sick person; who, by this means, they say, is delivered from a most miserable state here, and sent to enjoy great happiness in heaven†.

The people of *Arrakan* trade very little by sea. All their navigation extends no farther than *Bengâl* and *Pegu*; whither, upon occasion, they send their *Teliyasses* of war. For they neither covet subduing the possessions of other nations, nor of sending colonies into other parts; much less do they delight in foreign commerce. What trade they have is brought home to them by the merchants of distant countries‡. As the country produces timber for building, some lead, tin, sticklack, and elephants teeth, there are some of the *Great Mogol's* subjects who trade hither; and sometimes they meet with bargains of diamonds, rubies, other precious stones, and gold *Rupîs*; which says our author, are to be supposed some of Soltan *Sujah's* treasure, pilfered by the avaritious priests§: of which more will be spoken hereafter.

Whatever foreign commerce there is in *Arrakan*, it is carried on by the *Mohammedâns*, who are settled here in great numbers; particularly at *Bandel*. Some trade in elephants which they send to *Orisha* (or *Orixa*), the coast of *Choromandal* & *Golkonda* and *Persia*, in return for which, and other goods, they carry back calicoes, silks, spiceries, and the like. Very few are natives of *Arrakan*; but

† Schouten, p. 336, & seq.

* Ovingt. ubi supr p. 570, & seqq.
† Schout. ubi supr. p. 337.
‡ Ibid. p. 228.
§ Hamilt. ubi supr. p. 29.

come from other parts of *India* to settle there and dress as they do elsewhere.

The inhabitants of *Arrakan* are idolators; on which account, says *Schouteen*, they are called *Moges* (Q); worshiping devoutly their images, made of clay, baked in the sun*. They are very superstitious, and look on the barking of a dog, or the like, as the presage of some remarkable event. On every such frivolous occasion the priests are sent for; who know how to make their advantage of the people's folly. The idols in their temples are so numerous, that one of them is reported to contain no fewer than 20,000. They are built in the form of pyramids or spires. Besides the temple-idols, they have their domestic ones. To both sorts they offer victuals every day; and both are clothed by them in winter, that they might not catch cold. They wear the mark of their household god branded on their arms, sides, or shoulders. On their anniversary festival, in commemoration of the dead, they carry in procession one of their idols, *Quiay Poragray* (R); which is carried in a heavy chariot, with ninety of the priests, clothed in yellow sattin. Many throw themselves under the wheels, others hang themselves on hooks fastened for the purpose, and sprinkle him with their blood. These martyrs to folly are in such veneration with the people, that he thinks himself happy on whom one drop of their blood happens to light. Nay, the hooks are taken down by the priests, as sacred relicks, and carefully preserved in their temples. From these instances our readers may perceive, that the religion of *Arrakan* tallies with that of the *Hindûs*, in the hither parts of *India*; and their priests impose upon them no less by subtil artifices.

Their priests, called *Raulin*, or *Raulini*, are divided into three orders, distinguished by the names *Pungrîni*, *Panjani*, and *Shoshom*; something resembling the orders of bishops, priests, and deacons, in the Christian hierarchy. The chief of their priests is called *Shoshom Pungri*; which title imports as much among them as that of *Pope* does at *Rome*. On him depend all ecclesiastical causes, and he is had in so great veneration even by the king, that his majesty places him on his right hand, and never speaks to him without a profound reverence. The place of his residence, or see, is in the island of *Munay*, already mentioned. All the priest-hood are clothed in yellow (S), and have their heads shaven. All go uncovered, excepting the *Pungrîni*, or those of the first order, who wear a yellow mitre, with the point turned and falling backward. They are obliged by vow to live single; and, in case of disobedience, are degraded: by which means they are reduced to the condition of laics, and are taxed as such*.

To be continued.

* Schout. p. 239. 235.

(Q) Or *Moghes*. If this be so, we then learn what *Ovington* tells us, p. 582, he could never find, whence the king derives the appellation of *Moghi*, which he assumes.

(R) He is their supreme deity. See p. 580 of *Ovington*.—Captain *Hamilton* says, the name of the titular god of the kingdom is *Dagon*. Vol. ii. p. 28.

(S) *Schoutin* says, they wear black, which is the colour of modesty, as well as mourning, in *Arrakan*, Voy. vol. i. p. 335.

* Ovingt. p. 575, & seqq.

THE PROGRESS OF TEMPERANCE SOCIETIES AT THE SEVERAL MILITARY STATIONS OF INDIA.

We consider the effects of ardent spirits upon the health of troops so destructive that we shall make no apology for calling the attention of our professional readers to the progress of temperance societies. We have just received the last report of the Chunar Auxiliary Temperance Society, a station at which more scenes of debauchery and drunkenness among old invalids were once exhibited than at any other on this side of India; but such has been the effect of a Temperance Society there; that out of the few troops they have recorded no less than 108 members who have stood steadfast. We find from this report that during the last year, a branch association has been instituted at Buxar consisting of 52 members: an excellent beginning in proportion to the number of residents. A native Temperance Society has also been instituted at Chunar, consisting of 100 members. The following extract from the report affords additional proof that these societies merit every support the Government can give them.

"Another proof, if another were now wanting, of the absurdity of the opinion that ardent spirits are necessary to support strength under fatigue, has been recently furnished by the members of the European Regiment Temperance Society, during the late march of that regiment from Dinapore to Agra. On this interesting subject an extract may be given from the first report of that Society lately published. We quote

the whole passage verbatim; its inaccuracy of style cannot impeach the truth of the doctrine it advocates. "The opprobrium and ridicule, those who relapse and recede from the Society are exposed to; the probation they have to serve before they can be re-elected, and above all the noble example the late march afforded, of a body of 44 individuals (many of them reclaimed from excessive intemperance) completing a nearly two months' journey, exposed to the extremes of cold and heat, sometimes accompanied by rain, without having recourse to spirits, has made the Society better understood, and in the opinion of the Committee, placed it on a sure basis, inasmuch as it has led those who now join, it is believed, to weigh well what they undertake before doing so, and confirmed those members in their temperate habits; and afforded so striking a proof, that ardent spirits are neither necessary for increased exertion, arduous duty, nor fatigue; that since the arrival of the regiment at its destination, there has been an accession of 22 members to the Society, besides 110 individuals undergoing probation, giving a grand total of 4 officers, 2 medical warrant officers, 3 apprentices, 38 non-commissioned officers, 129 drummers and privates, and 13 women." The Committee desire to impress the result of this experiment on the minds of all those who, standing on neutral ground, still continue from afar to survey the operations and regard the objects of Temperance Societies with the eye of doubt or distrust. Facts are stubborn things. The advocates of Temperance ask but a fair trial for the principle of abstinence; let this be bonâ fide conceded, and they will entertain no fear for the result."

The cause of temperance we learn is gaining ground in other directions during the last year several societies were established in the Madras and Bombay Presidencies, one at Trichinopoly was organazed in February and has 249 members, besides some Ladies and 22 Gentlemen, who have come forward in aid of the society with liberal subscriptions. In conclusion, we beg to quote a passage from a letter from the Secretary British and For. Tem. Society, London, to the address of the Secretary at Chunar, which gives an unequivocal proof that the hydra-intemperance is about to receive a shock from which we sincerely hope it will never recover.

"Many persons have attached themselves to these Societies in America, and many more, though not members, are acting upon the principle of abstinence from distilled spirits;—10,000 Drunkards have heen reclaimed; 3000 Distilleries have been stopped; 7000 Dealers have relinquished the traffic; and 1000 Vessels sail without spirits on board. A Congressional Temperance Society has been formed of which members of Congress only are members. Temperance Societies were not introduced into this country till some time after their existence in America. The facilities of diffusing information in this country are not so great as in America, and spirit drinking is more bound up with the social customs of society in Britain than in America; which may, in some measure, account for the less rapid progress of these institutions with us. Still the friends and promoters of the cause have reason to be satisfied with its advancement and are encouraged in the attempt. One step of obvious importance has been gained—the bringing the subject under the attention of the British Parliament, and the appointment of a Committee of Inquiry, and the publication of the evidence. An effort will be made in the present session of Parliament to place the trade under some restrictions. The Committee rejoice in these movements in the national councils; while they confine themselves more particularly to the main object of the Society—to publish information by means of public meetings and lectures, and the distribution of Tracts; so as to convince the community to abandon the use of spirits as unfit to be used with safety as a common beverage, in any country, and thus to elevate the tone of moral sentiment on this subject."

FREE SCHOOL EXAMINATION.

Although we had made arrangements to be present during the whole of the examination of the children of the Free School, the nature of our professional duties was such as to prevent our attending until the examination of the first class was about to commence. This afforded us an opportunity of forming an opinion of the acquirements of the Senior Division of the children. We deeply lament to say they were such as to produce disappointment, and we may add, surprise, that after the expense in masters, &c. there should be such a great falling off. It was with satisfaction, however, we observed the children more healthy in appearance cleanly and better clothed, for which are we to thank the press? which receives much reproach, because it unmasks abuse, and demands on the part of the public efficient

management of public institutions. We would gladly have refrained from the foregoing comments, but we trust they will tend to produce greater activity in all departments of one of the most valuable institutions at this Presidency. We look upon the letter which appeared in the Hurkaru on the subject of the examination and was so much reprobated as a satire, worthy of the days of Swift, when the Press was in bondage and men dare not speak through any other medium. We look upon that letter as a piece of wholesome advice to those ministers whose duty we conceive it was to be present and take the most prominent and active part when the education of the poor was to be tested in the greatest public charitable institution in the Capital of India. The foregoing observations are made in ignorance of the cause of the absence of our clerical friends; but this we maintain, that if sickness or other circumstances prevented their attendance a note to the Secretary to be read at the Meeting would have shewn to the parents of the children that it did not arise from a disregard of the prosperity and welfare of the poorest portion of the rising generation.

MILITARY ORPHAN SCHOOL.

It will be in the remembrance of our readers that we stated in our Rejoinder, page 8, paragraph 20, the great difficulty we experienced in obtaining the published general statements to explain away paragraph 20 of the general management's reply, wherein they say if the numbers of our figured statements were reversed "*it would be more correct than at present*," and again they add "*and in no year does the statement exhibit the correct number;*" they then refer to a table at the end of the pamphlet in the appendix. Now we applied on the 30th of May to the Secretary for the general statements, but received them only on the 10th of June or five days after the printing of our Rejoinder, and instead of all the years for which we required them we were furnished with those only from 1825-6 to 1834-5. But we have sufficient grounds to shew that the errors charged against us are entirely applicable to the general management. We therefore retort that *in no year does their "statement exhibit the correct number*." The following is a correct copy from the general statements, the general managements, and our own.

Monthly average Number of wards and Boarders in the Upper Orphan School during the following years as noted by the General Management—as by general statments—as by Mr. Corbyn.

Year.	Gen. Mangt. Statement.	Gen. Stat.	Mr Corbyn's.
1832-33	161	160	160
1831-32	165	166½	166
1830-31	171	180¼	180
1829-30	179	178	178
1828-29	182	178¾	176
1827-28	180	176¼	126
1826-27	175	176¼	173
1825-26	179	173	264

Now we trust that the foregoing will induce the subscribers to send for statements which ought to be found in every Adjutant's office, and permit us again to impress upon the mind of all that valuable opinion of Locke's, "we should not judge of things by men's opinions, but of opinions by things;" for it is generally thought to be marvellously strange that an individual could be right and a body of men wrong; on this account the great portion of mankind judge men, not measures.

When our Subscribers examine Para 19, Page 11, General Management's Reply, we beg they will look at statements for 1831-32 and 1832-33, refer to the monthly average expense and receipts at the foot of the 1st paragraph, and they will perceive the accuracy of our statement. Also in proof of our accuracy in explanation of 16 paragraph, look to statements for 1833—34 and 1825-26, and with respect to paragraph 17, it is to be understood that the figures include deposits for boarders. We have alluded to these figures not that they have any thing to do with the main question, but because such errors have been laid to our charge. Indeed so trifling were they that if they even had occurred; we would not have deemed it necessary to delay the printing of our Rejoinder until we could obtain the General Statements.

TO CORRESPONDENTS.

The following works will be reviewed in our next, MacCleland on the geology of Kamaon. Trans. Hort. and Agricult. Society.

*** Several of our Subscribers have remitted 8 Rupees for 1836, for the Journal of Science whereas the amount is only 6 Rupees 13 Annas being for nine months at 8 per annum, the balance will be credited.

THE INDIA REVIEW

OF WORKS ON SCIENCE

AND

JOURNAL OF FOREIGN SCIENCE AND THE ARTS.

EMBRACING

MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS, &c.

REVIEW.

Some enquiries in the Province of Kamaon relative to Geology and other Branches of Natural Science, by Assistant Surgeon JOHN McCLELLAND, *Member of the Royal College of Surgeons, in London, and of the Medical and Physical Society, Calcutta, Oct. pp.* 384.—THACKER, & Co., CALCUTTA.

It has been said that no man can be considered enlightened without knowing something of Geology. Cuvier was the first to awaken research in this interesting science in our own country, and in Geology Britain now presents the first experimental School in the world. If we would know the importance of topographical and geological illustrations, we have only to examine the transactions of the Geological Society of London. By means of this science we learn what are the resources of a country, what are its mineral and vendible products, what are the organic remains in its rocks, volcanos, and other geological phenomena. It is this fascinating research which takes the man of science to survey the lovely face of nature, the sublime heights of the mountain, and to direct his attention in a profound admiration to the depths of the valley, the graceful aspect of the plains, the blue ocean, the broad lake, and the meandering river, all which come within the boundary of his enquiry. His view is not limited by the stupendous rocks which burst the angry billows: even the pebbles of the deep and the mountain stream afford to him equal interest. While tracing the torrent's source to the elevated mountain, which receives continual accession from melting snow, and swelling and bursting over its natural banks, carries with it over the face of the plains deposits of mineral substances as it passes along and finally forms delta and other rivers; his investigations are made on the sure grounds of mathematical, astronomical, and chemical demonstrations. There is no spot where he fails to discover the universal and everlasting physical records of diluvial action, and the physical and moral evidence of the surface of our planet having submitted at some period or other to the mastery of the waters. To the other departments of this important subject we therefore add the study of investigating whence at the depths of hundreds of feet, we discover the teeth and tusks of the elephant, whence the remains of other animals which once lived. But this science besides possessing such deep interest to the Philosopher, subserves greatly the cause of husbandry as regards the admixture of soils, the application of manures, the spreading of sea shells upon the sandy fields, the effects produced by lime, in the tenacious clays, &c. We could enlarge in rapturous praise of Geology as it advanees the cause of medicine and the arts, but we have not space. Taking this view of Geological knowledge, it is with no common feeling of delight that we behold a work, from the pen of Dr. McClelland, on the Geology of Kemaon.

Dr. McClelland opens his work by commenting on the present state of Geology in India, and affirming that he has laboured unassisted in this interesting field during the greater portion of his residence in the country, and therefore claims some knowledge of the causes which retard the cultivation of this science. Such knowledge is of importance to the scientific world; and consequently it becomes our duty to lay it before our readers, especially those in Europe who are deeply interested in the physical and geological character of India. Dr. McClelland says that it is painful to reflect that we are as ignorant of the physical structure of the immense empire of Hindustan as we are of that of China and Africa. But there has been sufficient cause for neglecting such important researches. The British Government in India, we lament to say, has never once to our knowledge afforded the least encouragement to men of science and learning to obtain information as to the physical structure of the country. We look to the labours of a Moorcroft, a Gerard, and a Burns as sanctioned more for political purposes than those of science, although, their exertions, it is to be hoped, were directed to this purpose, and there may be still something recorded of them which can be considered worthy of being placed by the side of similar information obtained in Britain, France, and America. We have some curious instances of this indifference towards science, which we have no doubt, will excite the surprise of scientific men in Britain and France. Dr. McClelland states on the authority of Dr Buchanan, that when the natural and artificial productions of Mysore were required to be known, he was directed to make esculent vegetables, cattle, farms, cotton, pepper, sandle-wood cardamums, mines, quarries, minerals, mineral springs, manufactures, climates, seasons and inhabitants, the chief objects of his researches. Now we are sure it will be conceded even by the Honorable Company themselves in the nineteenth century, that the list savours more of import and export than the love and glory of science. But Dr. McClelland states that a few years afterwards three gentlemen were selected to survey the then unexplored source of the Ganges, the only instruction they received was to determine the Geographical question.

There is no spot in the world which affords such materials for rich mineral and organic treasures as British India. The strata and sections of the surface of all Asia are upon such a grand scale that Geology might be studied with infinite advantage and without entailing expense upon the Government. We would therefore strongly urge upon their attention the vast importance of giving encouragement to individuals who devote their time and attention to it. The man who is enthusiastic in its pursuit necessarily makes great sacrifices; he foregoes all comforts; has to contend in a tropical climate with oppressive heat; indeed, he devotes his means, labor, and time exclusively to such research.

We have often thought that if France had been in possession of India, how science would have triumphed. Even under her present relation, we will venture to say, without the fear of contradiction, that her scientific institutions have attained greater perfection in Indian Geological discovery than any of those in Britain. She has sent forth repeatedly men of superior attainments with this single object. This is so notorious that it is scarcely necessary to advert to the circumstance beyond the bare allusion to the fact.

But we must pass on, not however without the expression of deep regret at the existence of such heartlessness on the part of the ruling power as has been hitherto displayed in the cause of science. Of which we shall afford ample proof immediately. But notwithstanding we altogether oppose the following proposition. Our author observes that the first great step in improvement would be the organization of Geological Societies in different parts of India.

"In order to give them practical effect, and to deprive them of the character of mere amateur societies, their expense should be borne by the state, and members thus freed from subscribing aught but their labours to their support. Libraries, consisting of all

the standard works on natural history, should be furnished at the expense of government, as well as all kinds of philosophical instruments and chemical apparata."

We are unquestionably of opinion that the less scientific institutions have to do with Government the better: such a connection would bring the noblest institutions in a state of the most abject dependence and bondage conceivable. As for ourselves, we ask liberty—especially in a Geological, Physical, or any other scientific institution, and we should like to see always, as we have seen at the Asiatic Society, men of authority and power take their seats only as members. We expect, and it is not unreasonable to expect, that Government should come forward with the powerful arm of support, not only as refers to pecuniary assistance, but as regards its influence in obtaining for such societies all the aid necessary to promote the object of their foundation. At this moment societies in India cannot support scientific men for the purpose of travelling and research; but the Government has many scientific men especially in the Medical Service, it may afford them employment during these times of peace and affluence, and thus give an impetus and encouragement to the cause. But as to the societies themselves belonging to Government, we deprecate the idea altogether. Under the principle of encouragement we have advocated, we readily accede to Dr. McClelland's following proposition.

"Stores of this kind should be supplied either to the public at large, or only to the members of the societies, at such low prices, as would merely cover the expense of their importation.

The importance of this may be understood, when it is known, that the expense and difficulty of procuring philosophical instruments, books, &c. in the Upper Provinces of India, amount to an almost total prohibition of them, thus causing a perfect suppression of individual industry in the cause of national improvement, as well as of science. With respect to those philosophical instruments in particular, whose only value in their accurate adjustment, the submission of the purchaser to the most exorbitant charges for them seldom protects him from disappointment, such as is calculated to induce him, if not to force him, to relinquish all his efforts."

Dr. McClelland hints that the financial officers of Government may entertain an opinion that the Physical class of the Asiatic Society is sufficient for all the purposes that are required. We differ from our author in the opinion that, however, useful the Society may have been in regard to the other branches of Science, it has in this; "really done nothing".

"I very much doubt, if their Transactions up to a very late period, contain one mineral description that would be received by a systematic writer as correct.* The objects of the Asiatic Society are too comprehensive to be of much use in the cultivation of geology; this science itself requiring a greater variety of attainments in abstruse details, than could be well discussed in a Society devoted to general learning.

In support of this fact, it is only necessary to refer to the Transactions of the Geological Societies of Great Britain, and compare what has been done by those institutions within the last few years, with the few geological papers to be found in the whole series of Philosophical Transactions of London and Edinburgh. The Royal Irish Academy is perhaps an exception to the rule here implied; but if so, it is owing only to the influence of Richard Kirwan, "the father of British mineralogy," whose writings on geological subjects attracted the attention of Europe, and gave a bias to the Society over which he presided, something like that which was occasioned by Newton in favour of mathematical philosophy. To the influence of Kirwan is ascribed, the honour possessed by the Dublin Society, of being the first institution in the British empire to endow a geological professorship. Yet, notwithstanding the interest evinced by already existing institutions in Ireland in behalf of geology, it has (I believe) been recently deemed expedient to increase their number, by the addition of a Royal Geological Society."

It is but recently that Geological researches have advanced, and if there has not been such numerous illustrations of this part of the globe since 1817, as our author expected, we must repeat, that it is to be ascribed to the fact that the rulers of the country have not encouraged this research, as a distinct object of attention; consequently the surface of our Indian empire has not

* The period to which I refer is 1817: since which time, some late and much lamented authors, have evinced their zeal in behalf of geology, by communications of great interest. The more minute, and consequently the most important, portion of their labours have not yet been published, and it is feared, will be ultimately lost to the world from the defects in our institutions here referred to.

been traversed in different directions. When men of science can however command a leisure moment from their other arduous professional employments, we find them engaged in scientific pursuits and papers of great value have been transmitted by them to the society. We have now before us two volumes of the transactions of the Physical class, one for 1829, the other for 1833, replete with the most valuable geological intelligence, and we boast in the face of the scientific world in Europe that they are worthy of a prominent place in their transactions. Let the reader refer to the Transactions of the Physical class for proof in the papers of Voysey, Herbert. Everest, MacPherson, Ward, Calder, Franklin, Low, Coulthard, Hardie, and others. We publicly avow our belief that if any mineralogist were to visit the Society's rooms now, and view the specimens in mineralogy, the arrangement of which is entirely due to the talents and labours of Mr. James Prinsep, they would receive a full and satisfactory proof that much has been done in this department. There are however a considerable number of specimens accumulated, which yet remain unexamined. These, we should be glad to see, rescued from their present situation, and we regret that other members of the Society should not have been found to come forward to assist their over-burthened, but willing and talented Secretary, whose zeal in Geological science entitles him to our warmest gratitude and admiration. Our author considers the objects of the Asiatic Society too comprehensive to be of much use in the cultivation of Geology. From the facts already adverted to, we think a separate Geological Society would be an advantage, although, such an institution would go far we fear, to ruin the present institution which is now so very poorly supported as scarcely to be able to defray the expenses of a curator for its museum. Of this we are certain, no friend to science would lend his aid in any way to the establishment of a Geological Society which would ruin the Asiatic. We would rather see the Geological branch, as it now exists, strengthened by more zealous exertions on the part of the members than risk an injury to the parent institution.

Dr. McClelland refers to the geological societies of Britain comparing what has been done by them with the few Geological papers to be found in the whole series of the Philosophical Transactions of London and Edinburgh. But we must not compare great Britain and her mighty institutions with the labours of the few scientific men in India, where the ability to have separate institutions is so small. In Britain, it is not necessary to give to the transactions of other societies the papers to which our author has alluded; but he himself gives a satisfactory reason for this difference in the following passage.

"Before the world became acquainted with the labours of Werner, Bergman, Scheele, Klaproth, Kirwan, and Haüy, geology could not be called a science, and its imperfect rudiments were then safely confided to Societies celebrated for general learning. When however its objects became defined, its importance pointed out, and principles laid down and established for facilitating our knowledge of the Natural History of the globe—for extending our researches into the chemical nature of the mineral substances, of which the crust of the earth is composed, and their uses in the economy of life: then did geology present itself to enlightened nations, as a science entitled to peculiar attention; and Societies composed of the most eminent men were suddenly called into existence. Great Britain and Ireland alone can boast of four such institutions: while our Indian empire, although it occupies a portion of the earth's surface, about twenty times greater, excites no interest or attention."

Dr. MacClelland is right to awaken attention to the subject of Geology, by shewing the importance of its study. But it is our duty to point out the real state of the case, and by our exposition to refute the charge—that there has been no interest or attention excited. We have already shewn, that were it only for the labours of Voysey, Herbert, Franklin, and the celebrated Dr. Heynes, they would sufficiently prove that the zeal, spirit, and talents so conspicuous in our native land has pervaded India. Dr. McClelland must at the same time consider the character

of the people who inhabit the Indian Empire. The enlightened portion would scarcely fill an English village. We will however join our voice to his and call out against the apathy of the majority of British sojourners which is in our opinion, too often improperly ascribed to the climate. Why is not a similar indifference evinced in commercial and other occupations in which we see an energy and devotedness which is not to be surpassed by speculators in any other part of the world. The following remarks shew however that a similar apathy existed in our own parent land. Dr. McClelland's observations on Mineral Topography are worthy of notice.

"Up to the beginning of the present century, the English even at home were sadly behind other great nations in this department of science, and from 1724 to 1799, nineteen works only were published on the mineral topography of districts in the United Kingdom.

In France, from 1750 to 1799, sixty-two, and in Italy, thirty-six works on mineral topography were published; while Germany and the rest of Europe contributed to the world, two hundred treatises on the same subject.

During the time the science of geology was thus progressing in Europe, (as well as in America, where twelve descriptions of districts were published about the close of the eighteenth century,) it may be curious to learn what attempts were made in India, either to improve the resources of our new empire, or to extend the boundaries of science. The papers on the subject of mineral topography of countries in the East Indies, up to the end of the eighteenth century, are *four*.*

The first of these is by Johannes Gerhardus König, and is published in the 4th volume of the Natural History Society of Upsal, entitled "Observationes Mineralogicæ, in India Orientali; e litteris ejus excerptæ à Joh. Jac. Ferber*."

The second is by James Anderson, and is, "An attempt to discover such Minerals, as correspond with the classification of Cronstedt, and thus lead to a more extensive knowledge of mineralogy in this country, the Coast of Coromandel, 1797*."

The third is by Carl Peter Thunberg; and was published in 1785, under the title of "Beschreibung der Mineralien und edlen steine, auf der insel Ceylon†."

The other is by Georgius Josephus Kamel, and is found in the early Philosophical Transactions, under the title of "De Mineralibus et Fossilibus Philippensibus‡."

It appears that much was anticipated by our scientific men in Europe, from the encouragement which Sir John Malcolm, when appointed Governor of Bombay, would give to the "Mineralogical examination of India." Sir John brought out with him Mr. Laidlaw, a gentleman educated as a Civil Engineer, and an excellent practical Mineralogist and Geologist. Our author says, that Dr. Thomson anticipated from the labours of this gentleman numerous discoveries as interesting to the scientific world, as they would prove of great importance to our Indian Empire. Of the encouragement Mr. Laidlaw experienced from "the triumphant Soldier and successful politician" Dr. McClelland speaks as follows.

"In the midst of the busy scenes into which he was hurried, forgot the humble, and perhaps eccentric, man of science; or abandoned him with all his faults and peculiarities to strangers, who may have expected to find him all perfection§. Whatever they

* Dryander's *Bibliotheca Banksiana*, vol. iv. p. 72.

* Dryander's *Bibliotheca Banksiana*, vol. iv. p. 72. Konig was the pupil and correspondent of Linnæus, and the founder of Oriental Botany. "He was singularly qualified for the employment he had entered into;" says Dr. P. Russell, (pref. Roxb. Plants of Coromandel,) "more covetous of fame than of fortune, he persevered in his pursuits with an enthusiasm that set bodily fatigue, *spare meals*, and a scorching climate, at defiance." He appears to have been supported during his labours by a pittance from the Nabob of Arcot; but three or four years before he fell a victim to science, we are told in the same work, that the "Madras Government, with the sanction of the Court of Directors, made an addition to his salary," i. e. an addition to the sum allowed him by the Nabob: he died suddenly before he had time to profit by his labours.

* Of James Anderson, we know little more than that he was an eminent physician in the army.

† C. P. Thunberg, afterwards knight and successor to Linnæus, in the University of Upsal; a fellow of the Royal Society, and of most of the learned Societies of Europe and America.

‡ Kamel, or Cameli, was a Missionary; and probably a native of Portugal. He made many valuable communications to the Royal Society about the beginning of the last century, regarding the Natural History of the Philippine Islands. He was probably the first European who described the tea plant, and his name has been bestowed by Thunberg, on a genus of plants nearly related to tea.

§ The position of parties in this case bears some analogy to that of Burke and his friend Barry; but, alas, how the great Indian statesman loses by following up the comparison. To the forbearance of Burke with the foibles of genius, the British nation is no doubt indebted for those sublime achievements of the painter that now adorn the walls of the Society of Arts. Burke saw that he must either bear with his friend's peculiarities—that he must at least endeavour to improve them only by gentle means, or that his country must lose the benefit of his genius.

may have been, it would be improper in me to remark very closely, on the unfortunate causes which led to the failure of this talented, and once enterprising, man in the noble design he had formed. I have said unfortunate causes; for such must be considered, whatever may have led to the frustration of a design, from which India might have derived so much benefit. Even this is not all that is, in this case, to be regretted; for in a country where any advancement in science depends on the enterprise, zeal, and assiduity of individuals, rather than upon a large community; the example of such a failure is calculated, justly or unjustly, to deter others from risking, not merely their lives and fortunes, but also their reputations, in a cause which has not hitherto been rightly estimated in India."

"That such a case should ever have occured, that an individual who surrendered his fair prospect of fortune and fame in his native land; and at the expence of a small private fortune, perhaps, equipped himself for a task of vital importance to India, should be heard to complain of any want of liberality, calculated to induce him to relinquish his design, is more than can well be conceived: yet such would seem to have been the case. For some unfortunate reasons, it was deemed expedient to withdraw all pecuniary support from the gentleman who had entered so nobly upon the task above referred to, and thus abandoned in one of the most remote corners of India; a term of seventeen years have now passed over him, without the means of even transmitting his property to a place where he might dispose of it, and by this means return disappointed and ruined to that home which he left under the brightest auspices. A deep sense of the injury he conceives himself to have sustained has destroyed his confidence in man, and suppressed the utterance of any complaint. To those who think and feel, as become the sympathies of our nature, this tribute, to the living author of a great design, will neither appear indelicate, or absurd; although his own wrath may be partly anticipated, as the consequence of my good intentions*."

The above is a melancholy picture, and we dare not comment upon it. We shall conclude this introductory portion of our review with an expression of concurrence in Dr. MacClelland's wish that some attempt may now be made to remove those obvious causes which impede the performance of useful operations; for there is but one permanent source of national prosperity in the words of our author, "the cultivation of natural resources."

* I must here express my obligation to Mr. L. for the liberality with which he placed his valuable library at my disposal, which as far as books were concerned, left me little to complain of during the latter part of my residence at Lohooghat; but, unfortunately, I was too much employed in practical researches at the time to admit much reading.

Art. II.—Transactions of the Agricultural and Horticultural Society of India, Vol. II. Oct. pp. 288. *Serampore Press*, 1836.

It is justly said that by bringing the art of Agriculture to perfection man becomes the Lord of the universe, subduing by his skill and industry every part of the surface of the earth and assuming that dominion which a beneficent Creator has allowed him. Thus it is through his operations that the earth is made to produce abundantly and in greatest perfection those vegetables which are necessary for his subsistence and health. The importance of the study of Agriculture is best shewn by adverting to the fact that in proportion as this art flourished so have nations become prosperous. Its antiquity is beyond that of all other arts. It can be traced to Adam, whom we find tilling the ground in the garden of Eden. The prodigious length of life which the antediluvians enjoyed prove in the opinion of many, that the art of agriculture was at those early periods in a very advanced state of perfection, at least it had made greater progress than it has in our day. In the time of Abraham agriculture was considered the most honorable employment; and such was the superstitious gratitude of the Egyptians that they ascribed the invention of the art to Osiris, and Isis and even the very animals employed in tillage demanded, in their opinion, a claim to their worship and adoration. The Kings of Persia laid aside their grandeur to eat with husbandmen once a month, and Xenophon declared that where agriculture succeeded prosperously there the arts thrived. But coming to the present period we may with perfect safety avow that as in Geology, so in Agriculture, Britain exceeds all other nations. The Royal and other Societies have done much to attain this end, but all modern improvements are justly ascribed to the industry and natural genius of the people. It is therefore with great satisfaction that we perceive our industrious countrymen who sojourn in India making the improvement of agriculture an object of public attention and encouragement.

Agricultural and Horticultural Societies are at this moment appearing in all parts of India, and the lively interest so conspicuous in the European has been imparted to the native. Sugar, Tobacco, and Cotton are articles which

have recently received improved cultivation; while the implements of husbandry in use among the people, are now being substituted by those of a far superior description. We need only mention that the introduction of the British plough with six bullocks performs twice the work of the native plough with twelve. This one improvement estimating the number of ploughs used throughout the country at one to every family of ten individuals, and three-fourths of the population of the British territories as agricultural, we have six millions of ploughs, which on an average probably are employed 31 days in the year, the saving of the half of labour at 3 Rupees a month for each man and the same for cattle, is calculated to amount to seven crores and twenty lacs of rupees per annum. But besides these immense improvements from the institution of these Societies the introduction of foreign seeds and the distribution of them over the country will promote the interests of the governed and the government to such a degree as to enrich the productions of India beyond all calculation. From the work before us, it appears that in the early part of the Society's operation these had been confined to what might be termed exotics, but it was deemed advisable to apply the efforts and funds to what was considered more consonant to the nature of the institution, the encouragement of the great staples of commerce. Sugar, Cotton, Coffee, Silk, &c With the view of stimulating improvements 20,000 rupees were accorded by government for premiums, and an experimental farm was established for which the annual sum of 10,000 rupees exclusive of rent was allowed, together with 4,500 for buildings and stock for the first year. This proceeding on the part of government shewed a political tact; for which it has not been conspicuous in other respects; for there could be no question that this sum, by improving the agriculture of the country, would eventually be returned more than a hundred fold to the treasury.

While the eyes of the local government were therefore thus open to the advantages which would result to the country from these institutions, the Court of Directors were also impressed with their importance, and sent out considerable quantities of upland Georgia, Sea Island, and Demarara Cotton Seeds, together with a saw gin for cleaning Cotton, Cotton Seed from Tenasserim and a consignment from America was at this time also distributed. The result of these exertions and the efforts of the Society are fully shewn in the work under review. The following are its contents.

ART. I.—On the *Bair* or *Ber Tree* By Baboo Radhakant Deb. II.—On the *Cape Fig*. By W. Cracroft, Esq. III.—Remarks on the cultivation and manufacture of *Sugar*, in the Pergunnahs of Chandpore, Bijnore, and Mindour, Zillah North Mooradabad. By N. J. Halhed, Esq. IV.—The Native method observed in Mysore of rearing plants for *Seed*. By W. Ingledew, Esq. V.—On the treatment of *Mangoe* and *Peach* Trees. By C. K. Robison, Esq. VI.—On the culture of *Indigo* in *Bengal*. Communicated by Geo. Ballard, Esq. On the culture of *Indigo* in *Tirhoot*. By the same. On the culture of *Indigo* in *Oude*. By the same. On the manufacture of *Indigo* By Piddinton. Esq. VII.—On the early sowing of *Cabbage, Cauliflower, Pease*, &c. By C. K. Robison, Esq. VIII.—On the culture of *Cotton* in Persia. By W. Bruce, Esq. IX.—On the cultivation of *Indigo*. By N. Alexander, Esq. X.—Directions for cultivating *Teak*. XI.—On a new *Wind Mill* for raising water. By D. Scott, Esq. XII.—Remarks on the culture of Cotton, in the United States of America. From Capt. Basil Hall's Travels. XIII.—On the culture of *Tobacco* in Virginia. *Ibid*. XIV.—On the best method of cultivating Now Orleans *Cotton*. *Ibid*. XV.—Further Remarks on *Cotton*. *Ibid*. XVI.—On the cultivation of *Cotton* and *Tobacco* in Central India. By Baboo Radhakant Deb. XVII.—Report on two samples of *Rice* from *Arracan*, by W. Warden. Communicated by W. Cobb Hurry, Esq. XVIII.—Method of treating *Artichokes*. By John Brightman, Esq. XIX.—On the cultivation of *Asparagus* at the Mauritius. By J. Newman, Esq. Superintendant of the Royal Botanical Garden. XX.—Report on some samples of *Silk* from Bombay. By W. Prinsep, Esq. XXI.—On the native method of preserving *Cuttings*. By Capt. Wade, Political Agent at Lahore. XXII.—Observations on the culture of *Cotton* in the Dooab and Bundelkund. By W. Vincent, Esq. XXIII.—On the use and preparation of *Arrow Root*. By C. K. Robison, Esq. XXIV.—On the *Wool* of the *Jeypore Sheep*. By Lieut. Barberie. XXV.—On the artificial production of New Varieties of *Cotton*. By H. Piddington, Esq. XXVI.—Method of preserving the *Cotton Plant* in Cayenne. XXVII.—On the cultivation of *Safflower* in the neighbourhood of Dacca. By Dr. G. Lamb. XXVIII.—On raising *Plants* from *Seed*. By J. Newman, Esq. XXIX.—Report on the cultivation of *Jute* and the manufacture of *Gunnies* in Bengal. By Baboo Ramcomul Sen. XXX.—Remarks on the progress of *Horticulture* at Cherra Poonjee, and on a method of grafting the *Apple* on the Khasiyah Crab tree. By W. Cracroft, Esq. XXXI.—On the production of *Silk* at Kamptee. By Miss Anna Calder, with a Report by W. Prinsep, Esq. XXXII.—On the manufacture of *Paper*. By the late Rev. W. Carey, D. D. The same subject continued. By Baboo Ramcomul Sen. XXXIII.—Remarks on a specimen of *Cotton*, gathered from a wild shrub. By the late C. F. Hunter, Esq. XXXIV.—Reports on the advantages of the *Saw Gin*, drawn up by Messrs. Patrick and De Verinne in reply to queries submitted to the Society by Government. XXXV.—Remarks on the *Cotton* of *Ava*. By Major Burney, British Resident. Forwarded to the Society by Government. XXXVI.—On the *Cotton* of *Cachar*. By Capt. Thos. Fisher, in charge of Cachar affairs. XXXVII.—On several kinds of *Cotton* cultivated in the neighbourhood of *Dacca*. By Dr. G. Lamb. XXXVIII.—On *Cotton* produced at Cuttack from Bourbon Seed, and its staple for spinning. By Mr. J. T. Weekes. XXXIX.—On the *Native Cotton* of the Garrow Hills. By Capt. A. Bogle,

Officiating Collector and Magistrate of Rungpore. XL.—Further particulars concerning the *Cotton* of *Ava*. By Major Burney. XLI.—On varieties of sample *Cotton* imported from *Liverpool*, with particulars of prices, &c. Communicated by Messrs. Willis and Earle. XLII.—Report of Jos. Willis, Esq. on *Cotton* grown at Duckinsore, by Mr. Hastie, from Pernambuco seed. XLIII.—Report of Jos. Willis, Esq. on specimens of Cotton raised by Col. Coombs at Palaveram. XLIV.—Remarks on the culture of *Upland Georgia Cotton* at Allahabad. By W. Huggins, Esq. XLV.—On the culture of *Pernambuco Cotton* at Tavoy. By W. Maingy, Esq Commissioner. XLVI.—On the culture of *Sea Island Cotton* in the district of *Cuttack*. By D. Pringle, Esq. Acting Collector. XLVII.—On the *Gossypium Accuminatum* of Dr. Roxburgh. By N. Wallich, Esq. M. D. XLVIII.—On produce of *Upland Georgia* and *Sea Island Cotton Seed*. By Major John Colvin, of Engineers. XLIX.—On the culture of *Sea Island Cotton* in Tirhoot. By Lieut. Col. Hamilton. L.—General Remarks on the Culture of the *Mulberry Plant*, mode of rearing the *Worm*, and instructions as to the best method of manufacturing *Silk*. By Dover and Norton, Great Winchester Street, London. LI.—On an improved *Machine for winding Silk*. With some interesting remarks relative to the comparative modes of cultivating the *Mulberry* in Bengal and Western Asia. LII.—Remarks on the *Raw* and *Manufactured Silks* of Assam. By Capt. Jenkins. LIII.—On the Soils best adapted for the culture of *Tobacco*. By H. Piddington, Esq. LIV.—On the cultivation of *Tobacco* in the province of Cagayan. By Col. Joseph De Hezeta. LV.—On *Tobacco* produced at Diamond Harbour, from Virginia, Maryland and Persian Seed. By Capt. C. Cowles. Particulars of the mode of cultivating and curing *Tobacco*, adapted by Mr. G. F. Hodgkinson, at Garden Reach. LVI.—Remarks on the proper Soil, and best mode of curing *Tobacco*. By Dr. Cassanova. LVII.—Account of the *Gum Copal Caoutchouc*, and *Tea Trees*. By Lient Charlton. LVIII.—On a disease incident to *Ulsee* and other grain. Communicated to Government by Capt. Sleeman. LIX.—Report on *Coffee*. grown at Russapuglah. By F. P. Strong, Esq. LX.—The *Prangass Plant*; Correspondence between Lord William Bentinck and Maharaja Runjeet Sing, relating to a supply of Seed for the Society, if procurable. LVI.—Remarks on the *Tea Plant*, and on the culture of *Ginger*, by G. W. Traill, Esq. LXI.*—Remarks on *Assam*, by T. Hugon, Esq. LXI.*—On the culture of *English Furze* and *Broom* in India. By Capt. Vincent. LXII.—On the culture of *Grape Vines*. By Capt. Sage, Experimental introduction of *American Cotton* and *Tobacco* in the district of Munipore. By Capt. Grant, LXIII.—On *Cachar Hemp*. By Capt. Jenkins. LXIV.—Observations on the best mode of preparing *Seeds* for transmission to India. By Jas. Gibbon, Esq. LXV.—On the *Ginger of Rungpore*, and the prospect of improving its culture by importing roots from Jamaica. By Col. Joseph de Hezeta. LXVI.—On the celebrated *Melon of Bokhara*. By Lieut, A. Burnes. LXVII.—On the culture of *Potatoes*. By Capt. Richmond. LXVIII.—On the culture of *Foreign Maize* as an article of food. By John Bell Esq. LXIX.—On the Manufacture of *Tapioca*. By the same. LXX.—Remarks on the *State of Agriculture in Behar*. by Jas. Gibbon, Esq. LXXI.—On the applicability of *Elephants* as a moving power for Sugar Mills, &c. LXXII.—On the culture of *Paddy* in twenty different districts. By Baboo Radhakant Deb. LXXIII.—Remarks on the *Raewash*, a species of Rheubarb, by Capt. Wade. LXXIV.—Society's Farewell Address to Lord William Bentinck. LXXV.—Lord William Bentinck's Reply to the Society's Address. LXXVI.—Report of a Committee on the subject of introducing the *High-Wheeled Cart* of Madras. LXXVII.—On the treatment of *Peach and Plumb* trees. By Lieut. Kirke. LXXVIII.—On the cultivation of the *Artichoke*. By T. Plowden, Esq. LXXIX.—Further remarks on *Assam*. By T. Hugon, Esq, LXXX.—A new method of *Grafting and Budding*. By Lieut. Col. D. Presgrave. LXXXI.—On a newly invented *continuous Still*. By C. K. Robison, Esq. LXXXII.—Instructions in regard to the culture of *Madder*. By G. F. Hodgkinson, Esq.

APPENDIX.

Report of the Society for the year 1835. Collector's Report. Proceedings of the Society. Regulations for the Agricultural and Horticultural Society of India, as sanctioned at a General Meeting, 11th March, 1835, Report on certain experiments made at Akra, in the growth of Foreign Cotton Sugar-cane and Tobacco.

ORDER OF PLATES.

1. Plan of a Mill for the raising of water, 2. Drawing of Saw Gin. 3. Plan of grafting and Budding. 4. Newly invented Still.

From this list we shall take some articles which appear to us calculated to shew the nature of the work itself, and to induce the reader to enter into the objects of the Society. The paper by W. J. Halhed, Esq. on the cultivation and manufacture of Sugar in the Pergunnahs of Chandpore, Bignore, and Mindour, and Zillah North of Moradabad, will be interesting to most of our readers, as there is only one paper on this subject, we shall quote it entire, and resume the review of the work in our next.

The land is broken up the month of Assar, and, after being exposed to the rains for the season, is manured and ploughed eight or ten times after the rains, and being cleared of weeds, is again manured and ploughed four or five times in February. Just before the cane is set, 4 cart loads of dung to each cucha beega, in low land, and 5 in high land, is the usual allowance: in general a cane field is ploughed from 15 to 20 times; it is well rolled after the 4 last ploughings, and also after the cuttings of cane are set. When the cane is set, the field is fenced with *urhur* sticks or other brushwood: 20 bundles of cane, each 210 canes, 8 inches long, are used for one kucha beega of land, in low land, and 25 bundles in high land: the value of the cuttings is at the rate of 5 bundles for 3 annas. When the shoots appear, which is generally in March and April, about 6 weeks after the cuttings are set, the earth, on each side of the cane furrows, is well loosened with a sort of hoe, with a sharp point, and broad leaf, in shape something like a mason's trowel: this is done 7 times; (the first time it costs 7 annas; the other 6 times 3 annas each time,) and the field is laid out in beds and channels for irrigation. If the season is usually dry, the fields, in the low ground, are watered in May and June, by means of wells dug for the purpose, as the water is not more than 12 feet from the surface: the price of labor for watering twice is 3 annas per beega, in the high lands. If there are no nullahs or ancient puckah wells affording facilities for irrigation, the cane takes its chance, as the cost of a kucha well, on the uplands, (from 10 to 20 Rs.) would be too heavy for an individual cultivator, and there are not many who would be found to agree to dig one in partnership, or could abstain from fighting about the water afterwards: a kucha well, too, lasts but one season only, as the soil is light.

The khadur, or low land sugarcane, is ripe in Kartick or October; that on high lands in November, when all the inhabitants of the village are em-

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* Repeated by mistake.

ployed in the work, or in looking on;—it is to them the most interesting period of their lives, whether they are concerned in the profit or not.

The sugar mill has been sunk in the ground, the furnace covered, the boilers fixed, and the earthen plates for casting the boiling sugar have been well dried in the sun, a store of fallen leaves have been collected to be used till the mill trash shall be dried sufficiently to serve for firing, and all preliminary arrangements made a fortnight before, when the village priest determines a fortunate day for the commencement of the work, after which the furnace cools till all the sugarcane juice has been extracted and boiled; the mill, put in motion by the pair of bullocks, which are relieved from time to time, begins working at about 5 o'clock in the evening, and does not stop till 9 or 10 o'clock the next morning; this period of about 16 hours, more or less, is called *Oseruha* or dew fall, and the average produce is 12 Koondees of juice, each Koondee 6 Bahnees, each Bahnee 6 Syas, each Sya contains about 3 half pints English, or rather more; say that each Koondee then contains about 28 quarts, or seven gallons English, the average produce of a Koondee of juice, when boiled up, is 12½ seers of Goorh, each seer of 96 Sa. Wt.; the produce of the mill's work then is 175 seers, or 4 mds. 15 seers—the juice is formed into Goorh, which is the mere inspissated juice; Shukkur, which is a coarse granulated sugar, made by mixing a small portion of Reh or native soda with the Goorh, when it is in the melted state on the mud plate on which it is cast—the Rab or Khaud, which is a finer production, and from which the molasses can be afterwards extracted by pressure, which is not the case with Goorh or Shukkur; a Koondee of juice will give an average of 15 seers of Rab; the night's work, or 12 Koondees, will give, consequently, 4 mds. 20 seers of Rab.

Koondees.	
Best land,....	20
Next best,...	16
Next,........	12
Poor land or neglected,.	8
	4 | 16
Average,..	14

The average produce of the beega of sugarcane is 14 Koondees of juice, as per margin.

Pucka beega 2304 square yrds.

The following is a table of the expences of a puckah beega of sugarcane cultivation, supposing that the owner has his own bullocks; the pucka beega contains 3 kutcha beegas:—

*Land tax 3 kutcha beegas 3 Rs. 13 As. 3 P. + 3	11	7	9
Ploughing 15 times, at 3 As. 9. P. pay of the ploughman, supposing the owner to have no kumherahs and unable to plough himself,........................	3	8	6
Rolling four times....................	0	2	3
Manuring at 3 As. the kutcha beega, if the dung is the field owners' property, otherwise double, ...	0	9	0
Cuttings for the plant at, say 20 bundles per kutcha beega, 12 As. 3 P. + 3,..	2	4	0
Hoeing and weeding 7 times, 1 R. 9. As. 6 P. per kutcha beega...	4	12	6
Watering twice at 3 As. the kutcha beega each time, ...	1	2	0
The Putworee's fee ½ an anna per kutcha beega,..............................	0	1	6
The zumeendar and malgoozar will claim his fee at 2 As. per beega..........	0	6	0
Total Rs.	24	5	6

EXPENSE OF MANUFACTURING SUGAR.

The whole of the labor is paid for in kind, and the mill and cattle are assumed to be the property of the owner of the field.

The Gooryee or boiler, receives a Sya, or rather more than 3½ pints of juice, which is not taken into account, and 3½ seers of Goorh or Shukkur, per diem.

The Perheeas, who put the canes into the mill, receive, between them 6½ seers of Goorh.

One Jhoka or fireman, who feeds the furnace, receives, per diem, a Sya of juice and 1½ seer of Goorh.

The carpenter and blacksmith receive, for each day's work, between them, 2 seers.

Three mootheas, who make up the canes into bundles, to give to the millers, receive, between them, for a day's work, 1½ seer.

Two gun-kuttas, or cane-cutters, receive, between them, 4 canes a day and 1½ seer Goorh.

The village chumar, for the leather used in the mill and harness, receives daily 1¼ seer Goorh.

If the field owner has a Kumherah, or hereditary ploughman, he will give him, at the end of the season, five seers of Goorh, a blanket, and a Rupee for the land he has assisted to till.

And the chowkeedar will also receive 5 seers of Goorh, at the end of the season, for watching.

Six Rupees a season are paid for the use of the set of 3 boilers, by those sugar cultivators who have united to hire them.

The daily expenses of the mill will be 16 seers and ¾; its produce is 3 mds. 30 seers of Goorh Shukkur, or 4 maunds of 20 seers of Rab.

The manufacture of the produce of one puckah beega will take up, say 3½ oserahas.

The manufacture will cost 1 md. 18 srs. Half the proceeds will be of Goorh and Shukkur, 13 mds. 5 srs.—of Rab, 15 mds. 13 srs. Deducting the expense of manufacture, the following will be the average net produce of sugar from the pucka beega of canes:—Goorh and Shukkur 10 mds. 26½ srs. Rab 14 mds. 1½ srs.; its value, Goorh at 17 seers, 33 Rs. 10 As. Rab, at 15 seers, 28 Rs. 7 As. Say that half the juice is made into Goorh, and half into Rab, the value of the net produce is 31 Rs. 0 As. 6 P; from which deduct the land tax and expenses of cultivation, there remains to the cultivator a profit of 7 Rupees 1 Anna per puckah beega, of which say that 9 Annas more is deducted on account of the Chowkeedaree, hire of boilers, and other village expenses, 6 Rs. 8 As. clear profit remain for every pucka beega; and if he has Kumheras, or hereditary ploughmen, servants, and children, whose labor is available, he saves further, say half the expense of weeding, or 2. 6. 3., and and the whole charge of ploughing and manuring, or 4. 1. 6., and of watering 1. 2.; total 7. 9. 9. for each pucka beega in addition.

This first crop is called Podha and in good lands the cane stumps are left for a second crop, called Perhee, by strong handed cultivators, (i. e.) those who have kumherahs and grown up sons and relatives in the family, available: the field, requires the following processes:

Watering, 5 times,..........	2	11	0
Manuring,.........	0	9	0
Hoeing and weeding, 5 times,........	7	19	6
Putwarees' fees,...........	0	1	6
Malgoozars' fees........	0	6	0
	11	11	0

The value of produce will be nearly similar, say 30 Rupees, which, after deduction for land tax and expenses of culture, or in all Rs. 23 2 9, leaves a profit of 6 13 3 per pucka beega to the cultivator.

The following crop is either of wheat or Patna rice, or a mixed crop of mustard seed and barley, the returns of which will give from 6 to 6 8 Rs. per beega profit. It is seldom that poor lands are ever laid out in sugarcane, so the average of produce is in reality much higher than has been given above; while the expenses of culture and land tax are quoted at their highest rates—the canes are tied together and wrapped round with the leaves of the plant, hoed and weeded—the cane tops (Azhola) used for feeding cattle, are not taken into account

* Not the Government land tax, but the rate levied by the malgoozar or contractor for revenue.

as the sale price of what is not used for feeding the mill and ploughing cattle, (say 3 pairs of bullocks) or about Rs. 4-8 is a set off against the wear and tear of ploughs, mills, and cattle, as few if any cultivate sugarcane who are not possessed of means and spare hands, sugar speculation is not a bad one for an agriculturist.

Art. III.—Journal of a Tour through the island of Rambree, with a Geological Sketch of the Country, and Brief Account of the Customs, &c., of its Inhabitants. By Lieut. WM. FOLEY. *Journal of Asiatic Society*, 1835.

(Continued from page 118.*)*

We left our author at the *Kioums* of the priests, and it will be seen from the extracts which we made that they have merited the notice which has been taken of them. As we are however, anxious to give to such of our readers as may not have access to the original, as full a conception as possible of the habits of the Mughs, we shall merely take occasion, in continuing our Review, to offer a few passing remarks, because with the object we have stated, we prefer to offer them as large a portion of the work itself as our limits will permit. In the large towns and villages it appears that education is almost wholly confined to the *Phoongrees*. The offspring of rich and poor are without distinction similarly treated in the course of their tuition; nor is any remuneration exacted by the teachers for the trouble they undergo, beyond the daily provision of an eleemosynary subsistence from the native community. Children are not received into the *Kioums* under the age of nine. The out-of-door discipline, which consists of fetching wood and water, cleaning the rice, and attending the priest in his daily round for food, being considered too severe for a less tender age. Orphans and the children of distant residents are both fed and lodged at the seminaries. The other boys are permitted a specified leave to go home for meals, but must sleep in the *Kioum*, because what they have read during the day "is repeated in the evening or at day break the following morning." Our author informs us that this is not the only method of education, observing that there is another "equally peculiar to the Mughs."

"There is another source of education equally peculiar to the Mughs; such as are not engaged in any pursuit or employment requiring all their time, devote a portion of it to the education of children entirely gratis; less labour being expected from the children than is imposed upon them in the *Kioums*. Children under nine years of age and of both sexes are admissable to such schools, the rules, as before observed, being less strict than those enforced at the monasteries; it is therefore not uncommon to meet with children of a very tender age at such schools."

There are nunneries as well as convents, and the *Bhi kuni* (nuns) are as common as the priests. They reside either in the nunnery or at some separate house near a *koo* (temple) superintending offerings and leading a life of abstinence. The major part of these are vestals; but there are others who have retired from the world at more advanced ages. Married in some instances, but only in those wherein matrimony has been unproductive. The habiliments of both monks and nuns are alike and the discipline is in every other respect similar. The respect shewn to the priesthood while living is strongly confirmed to our author's understanding by the honors which are done to their remains. The scale of this necessarily depends on the ability of the parties: but if it happens that the population in the vicinity of a *Kioum* is wealthy, the "magnificence" and expense is not under that of their most costly shews—

"When emancipated from the world, the body is opened and embalmed; after which it lies for many weeks exposed to public view. The body is then confined in a coffin, richly embellished with gold and silver leaf, and this is placed upon a lofty car that had been constructed for the purpose. The inhabitants of the neighbouring villages flock to the spot, and ropes having been fixed to the fore and hinder parts of the car, a contention arises among the villagers for the remains of the *Phoongree*. One party pulls against the other, and those that are successful claim the honor of finishing the ceremonies. This is done by a grand display of fireworks, the greater part of which are skilfully directed at the car, which is at length set on fire and the body is consumed*. Should the deceased

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* See a full account of the same ceremony by the late Rev. Dr. CAREY, As. Res. xii. 389. —ED.

Phoongree have maintained a character for peculiar sanctity, a part of his remains is not unfrequently preserved from flames and retained as valuable relics. The influence of superstition has attached much value to such remains, and in addition to the worth they may be supposed to possess from the religious character of the departed priest, they are held by the more ignorant to be a common ingredient in those charms that are in use with the wizard.

The Mughs hold the practice of burning the dead to be more honourable than that of committing the body to the earth or the sea, probably from its being attended with greater expense and publicity. Funerals are, however, conducted in either way, according to the means of the relations, or other circumstances favouring the adoption of one particular practice. The spot on which a funeral pile had been raised is not unfrequently marked by a cenotaph, a garden, a clump of trees, or such other monument of affection as the condition of the parties will enable them to place over the ashes of a departed relative. In some cases, the funeral rites are followed with donations of food and clothing to the priests, and a further evidence of piety is evinced in the adoption of some young man who shall express his readiness to embrace the profession of a *Phoongree*."

Leaving *Ladong* our traveller proceeds to Woogah. The distances of the stages he has already traversed are thus stated. From *Khyouk Phyoo* to Kyouprath 16 miles: from thence to Ladong, by computation 20; and then to Oogah 12 more. The villages in the Ladong district are described as "remarkably large" having a cheerful and comfortable aspect; and the whole face of the country but for the costume and features of the inhabitants and particular construction of the houses bore a striking resemblance to Bengal. Lieut. Foley assumes that the general appearance of the Mugh would indicate a condition "infinitely superior" to that of the poorer classes in several parts of India. His coarse though ample clothing, of home manufacture, and vigorous frame, attest that he is sufficiently provided against the climate, and nourished in his body, his wants being but few and readily supplied, there is no necessity for that "unremitting labor," by which the poor of other countries support themselves. The earnings of one day suffice for three, and to the more indolent the forest and the sea afford "an inexhaustible supply." hence Lieut. Foley deduces that characterestic apathy of the Mugh, that indifference to the future "which is generated by a consciousness of present superabundance, and he remarks that "until some *artificial wants* are produced by a taste for luxuries hitherto unknown," that these people will continue to be less anxious than their more civilized; but probably "less happy and less healthy" neighbours. He thinks, however, that the traces of such a change are already perceptible amongst those who are directly in contact with Europeans and natives of India.

"In the towns of *Khyouk Phyoo* and *Rambree*, we may observe this indication of the growing taste for articles of foreign manufacture, in the small investments of cutlery, glass-ware, muslins, and broad-cloth exposed for sale in the shops along with the produce of the country. The people have already become smarter in their dresses, and were a little more attention paid to their pattern of piece goods, I have no doubt but the sale of these would be far greater than it is at present. Long habituated to a state of being little remote from that enjoyed by the brutes of the forest, the present generation are prepared to value those little luxuries denied to them during the reign of Burmah, despotism, and will not be slow in securing the possession of them if placed within their reach. It is amusing, though melancholy, to hear these poor people relate the state of things in former days, in as far as regards the importation of foreign produce, and the prohibitions that debarred them the privilege of wearing the muslin turban or angah, even were they sufficiently wealthy to purchase the materials for one. As any exportation of the staple produce of the soil was seldom or ever permitted, few returns were made in the shape of Europe or Indian goods. They did, on some occasions, find their way into the country by the *Godoohs* that returned from Calcutta and Chittagong, laden with such articles of Europe or Indian manufacture, as the owners were enabled to obtain in exchange for the gold leaf, deer horns, bees' wax, and earth oil, the produce of Ava and Arracan. The demands of the Burmah *Kaeng**. And the numerous exactions, with the expenses of a long and dangerous voyage, were, however, thrown with such severe but necessary weight upon the original prices of the several commodities imported, that none but the rulers of the land would venture to evince a disposition to become possessed of them.

Property has now become comparatively secure; a stimulus has been given to industry by the freedom allowed to the exportation

* Collectors of customs. The duty levied was usually as much as ten per cent. and not unfrequently paid in kind.

of produce; with an increase of production there will be an augmentation of capital, and the agriculturist may look forward to the attainment of those articles of comfort and luxury hitherto denied to him. Still this change for the better will, of necessity, be very gradual. It is as it were a newly discovered land, and as such it will require the united efforts of capital and labour (joined with skill), to bring its resources into play. As is well known, the staple produce of the soil is *rice*. Great quantities of this grain are annually exported to Madras and Penang: the returns being generally made in kind, and consisting chiefly of Madras cloths and Europe muslins, which are either sold in Arracan or retained for importation into Ava. I am not aware that any other article of agricultural produce is exported from *Rambree*. Both cotton and indigo are, however, grown upon the island, the former on the mountain side after it had been cleared of the jungle; tobacco is also produced in the ravines and clefts of the hills, subsequent to the accumulation of alluvial soil deposited therein by means of a dam so constructed, as to oppose its escape with the torrent. But neither of these are produced in such abundance as to permit of a large exportation: the quantity grown being little more than sufficient for consumption in the province. A want of capital, and perhaps a want of confidence in the Government, prohibiting agricultural speculation, the production is generally confined to what may be deemed sufficient for domestic purposes, or be grown with the sure prospect of ultimate reward."

The geological features of the country between *Ladong* and Oogah presented no peculiarity; the soil being a rich clay mixed in some degree with sand, and sandstone the prevailing rock, its inclination, wherever it could be observed "being still to the S. S. W. and S. W. parallel to the bearing of the hills."

"Leaving the stubble fields of *Ladong*" our author once more proceeds along the beach and sees the village of Oogah before him "very prettily situated on a bight of the sea." The prospect from the village is said to be very fine, "beyond it, on the land side, lay *Jeeka*, the highest mountain in the island, and immediately opposite to it was the island of *Cheduba*, with its blue hills and undulating plains," a small vessel called a *Godoo*, was at anchor between the islands bound to *Bassem*, with beetlenuts and sundries. The *Soogree*, or revenue Collector, and also head man of the village came out to compliment the stranger and to escort him to his dwelling house, in front of which a *muchaun* had been constructed for the repose of travellers, and whereon our traveller rested until a room could be prepared for his accommodation. He was cautioned, however, against his wish to sleep on the same platform during the night, from the dread of tigers which were frequently prowling about; and fortune favored him, for one of these ferocious animals actually visited the village during the night and created great alarm. The Collector seems to have been in easy circumstances; abundance of poultry and cattle with the supreme additional blessing as he supposed of two wives.

"Polygamy is common enough in Arracan. There appears to be no limitation; a man may keep as many wives as he can afford to maintain. The consent of the first wife should, however, be obtained previous to the conclusion of a second contract. It is seldom that a refusal is given, and equally seldom that attention is paid to it. Retaining the privileges of a mistress, and probably aware of her inability to enforce a compliance with the restriction she wishes to impose, the elder wife usually signifies her readiness to receive into the family a second helpmate for her husband. This new alliance is seldom resorted to before the first wife shall have ceased to retain the charms of her youth, and have become incapable of performing the several domestic duties incumbent upon her."

Betrothing during infantine years as in India is unknown, generally, although instances will sometimes occur that marriage has been the result of a preconcerted arrangement between the parents. Similar instances though probably yet more rare ones, may be adduced even among Europeans, but these merely form the exception to the national custom, and the young people are "not unfrequently" permitted to form their own engagements, the consent of the parents being readily obtained when there is no striking disparity in the years of the parties. It would be common place to cite the universally acknowledged tokens of a pure and mutual affection; but there is one on the part of the female that is somewhat out of the way. Cheroots, the manufacture of her own hand, convey her sense of the happiness she derives from the assistance which her lover has given to her labors. When the attachment is declared to the father

and mother, the astrologer is consulted, *secundum artem* in all places, and if the result of his calculation proves favorable, the arrangements are made for completion of the affair. First of all a present of a fine silk dress, some gold and silver ornaments, and little tea mixed with spice are sent from the lover to the young lady, and then he follows in the evening of the same day, proceeded by the "young unmarried men of the place," who block up his course until he finds the means of opening by douceur of money. Arriving at his mistress's dwelling, the unmarried females enact a similar fine, when having cleared his path he enters the house, and the bride seated by his side "flowers and water are scattered over both by the hands of the oldest and most respectable person present." This done they partake of a meal prepared by the parents of the girl, the hands of the bridegroom and bride are laid on each other (that of the latter uppermost) and washed by the same person who had sprinkled the water and flowers. The father of the Bridegroom then takes a ring and places it on the third finger of the bride's left hand. The marriage is now complete and an entertainment follows, which concludes the ceremony. The bridegroom remains with his bride at her parents for 7 days preparatory to taking her home. Such is the general practice; but a man may without discredit select a partner without going through these ceremonies, and be equally certain of receiving respect from his countrymen. The woman being regarded in the same light as if formally united.

With every blessing there will be some reservation in its measure; and the lamentable consequence of what follows appertains to more regions than these where it was supposed civilization or the lights and the shadows of a more advanced state of existence were introduced with the foreigner and the conqueror.

"A *prostitute* was a being unknown to the *Mughs* before the country had fallen into the hands of the British. Among the blessings attending the change of rule and marking the progress of *civilization* in Arracan, is the introduction of a gradual increase of that unhappy class of people, and with it the miseries that are consequent to an unrestrained and promiscuous intercourse. To the honour of the *Mugh* women I must declare, that instances of prostitution on their part are still of rare occurrence; the reputation for this vice is still more generally attached to their *more civilized* neighbours the *Bengalees.*

So much liberty being allowed to the sexes in early youth, it may be supposed that an unlicensed intercourse will, in many instances, be found to exist between them previous to their union. It would be unreasonable to affirm that a passion which is so often known to break through the bounds imposed by religion and morality upon a people who claim for themselves a superior degree of civilization, should not in this country be known to exist in an equally unbridled state, and produce the evils consequent to an unrestrained intercourse and the shame of an avowal. Instances of abortion or bastardy are not, however, of frequent occurrence, the good sense of the parents, to whom the attachment in its several stages is generally known, preventing by a timely union of the parties, the evil which must originate from an intercourse unsanctioned by custom and authority."

As yet from the infrequency of application for divorce which is easily obtained amongst the Mughs, it should seem that the harmony of the married state has not been much broken in upon. How long this will continue is hardly problematical, for we find that the invader has already been at work, and that pristine simplicity is likely to sink fast under its proximity to those who boast of their loftier intellect and more reflective powers. We have avoided all observation of our own, save such cursory ones as have been thus elicited because we wish to give the substance of the work itself, as connectedly, as we can, intending when we have gone through, to offer a few suggestions upon its subject matter generally; for the present we must content ourselves with one more extract on the manner of divorces, and refer our friends to the next number for a continuation.

"Separation may be effected (privately) by a deed drawn out by husband and wife, and witnessed by two or more respectable neighbours; or both parties may appear before the *meeo-woon* or magistrate, and a separation is instantaneously effected on their compliance with the rules laid down for observance in such cases. If the wife objects to remain any longer with her husband, and he shall be found to have repeatedly ill treated her, she is at liberty to depart, receiving from him the whole of her property, as well as the children

(both male and female), that may have been born to her. The children are, in maturer years, allowed to reside with either parent as choice directs. If, on the contrary, the wife shall be found to have behaved ill, she pays a certain sum of money (generally about 25 or 30 rupees), to her husband, who also retains possession of the male children; the wife receiving no part whatever of the property. In cases where no criminality is attached to either party, and both desire to be separated, a fair division of property is made, each receiving what he or she may have possessed before marriage, with and equal share of the produce of their united labours; the husband retaining the boys, and the wife the girls. The case being investigated and decided upon, a *pawn* is broken into two pieces, one of which is given to each as the emblem of separation. This done, the divorce has been effected, and they are both at liberty to contract any new alliance."

GENERAL SCIENCE.

NOTICE OF SOME RECENT IMPROVEMENTS IN SCIENCE.

COMPOUNDS OF AZOTE.—In organic chemistry we can separate from one substance, by means of different re-agents, a number of bodies differing very materially in their nature from the substance in which they were previously combined. To ascertain if this fact held good in reference to inorganic substances, Liebig submitted to examination a ternary compound, which he formed in the following manner: (*Ann. de Chim.* lvi.) He passed through a solution of sulpho-cyanodide of potassium a current of chlorine gas. When boiled with dilute nitric acid an orange-yellow body precipitated, which, in its composition, was identical with the radicle of hydrosulphocyanic acid. Hence, he considered it as sulpho-cyanogen. This substance, when heated, is decomposed, and a quantity of sulphur and sulphuret of carbon comes off, while a yellow powder remains, which was employed by Liebig in his sub sequent researches, Liebig terms this citron-coloured powder *mellon.* When exposed to a temperature at which glass melts, it is decomposed into pure cyanogen and azote. Analyzed with oxide of copper, carbonic acid and azote are procured in the proportion of 3 to 2. He considers it composed of Carbon 458·622 Azote 708·144 Total 1166·766 and explains its formation by conceiving 2 atoms of sulphuret of carbon $= 2\ C + 4\ S$ and 4 atoms of sulphur to be subtrated by the heat from 4 atoms of sulpho-cyanogen, whose composition he states $= 8\ C + 8\ A + 8\ S$. There remains therefore $6\ C + 8\ A$.

Mellon, when heated in dry chlorine gas, combines with it and forms a white body, possessing a strong smell, and acting upon the eyes. The same substance may also be procured by heating together two parts chloride of mercury and one sulpho-cyanodide of potassium. In a current of dry chlorine gas. With potassium mellon combines and forms a transparent easily fusible mass, which dissolves in water, imparting to it a taste of bitter almonds, precipitating the metals not as cyanodides, and is decomposed by the agency of acids.

2. MELAIN.—The substance is procured from hydro-sulpho-cyanate of ammonia, a salt which is formed by distilling together two parts of muriate of ammonia, and one part sulpho cyanodide of potassium. The composition of the hydro-sulpho-cyanate of ammonia is analogous with that of urea, sulphur being substituted for the oxygen of the latter. When heated, the first effect is to disengage a considerable quantity of ammonia, then sulphuret of carbon, and soon sulphuret of ammonia appears in the neck of the retort. After the distillation is over a new subtance is observed in the retort, mixed with chloride of potassium and sal-ammoniac. By washing, the salts are taken up, and the grey matter called melam, which remains, is insoluble in water, ether, and alcohol. It is frequently mixed with a little sulphur, which may be removed by levigation. It is decomposed by a strong heat into ammonia, cyanogen, and azote. If it is boiled in potash it readily dissolves, and the filtered liquor deposits a white granular matter, which is melam in a state of purity. Analyzed by means of oxide of copper, melam yielded. Carbon 30·550 Hydrogen 3·860 Azote 65·589 Total 100·000.

When boiled with nitric acid it dissolves, and crystals of cyanuric acid doposited on cooling. Fused with potash, cyanic acid is formed. Boiled with a solution of the same, and concentrated, it doposits crystals. The supernatant liquor retains a trace of this substance, which is precipitated by sal-ammoniac or carbonate of ammonia, affording a white gelatinous product, identical with the substance procured by treating melam with muriatic acid.

3. MELAMINE.—By this name Liebig distinguishes the substance which has just been described. To obtain it in a state of purity, he recomends taking the residue after the distillation of 2lbs. sal-ammoniac, and 1lb. sulpho-cyanodide of potassium, and adding to it a solution of 2 ounces of potash in 3 or 4 of water, and boiling them until the liquid be quite clear; after which it is to be filtered and evaporated gradually, when crystals of pure melamine are deposited. These crystals are octohedrons, with a

rhombic base, in which the angles are about 75° and 115°. They are white, contain no water, and are not altered by the air. Cold water dissolves very little melamine, but hot water readily dissolves it. Melamine, combines with all the acids, and forms very characteristic salts. When heated with a solution of sal-ammoniac it gives out ammonia, and combines with muriatic acid. The sulphates and nitrates of copper, the salts of zinc, iron, manganese, are decomposed by a solution of melamine in water, and the oxides are precipitated. Fused with potash, cyanate of potash is produced; if it is in excess, mellonuret of potassium is formed. Liebig found the composition of melamine to be Carbon 28·460 Azote 66·673 Hydrogen 4·865 Total 100·000.

Melamine, heated with nitric and sulphuric acids, yields ammonia, and a substance which remains dissolved in the acid, and is identical with the product of the action of concentrated acids upon melam.

Melamine has a strong affinity for sulphuric acid. The formation of needle formed crystals is the result of their combination, which are scarcely soluble in cold but easily soluble in hot water.

NITRATE OF MELAMINE.—Is readily formed by adding nitric acid to a cold solution of melamine in water, until the liquid be strongly acid. It is in the form of long needles. By combustion this salt gives carbonic acid and azote, in the proportion of 6 to 7.

When a solution of melamine is added to nitrate of silver a white crustalline precipitation ensues, which consists of

1 atom	melamine	16.
1 "	nitric acid	6·75
1 "	oxide of silver	14·75
		37·5

OXALATE OF MELAMINE—Is less soluble in water than the nitrate. It affords, by analysis, carbonic and azote in the proportions of 8 to 6, and obviously consists of

1 atom	melamine	16.
1 "	oxalic acid	4·5
1 "	water	1·125
		21 625

ACETATE OF MELAMINE—Is very soluble in water, and crystalizes in large rectangular flexible plates.

PHOSPHATE OF MELAMINE—Is very soluble in boiling water. A concentrated solution leaves, on cooling, a white mass formed of needles placed concentrically. *Formate of melamine* dissolves easily and crystallizes.

4. AMMELINE.—This substance remains in solution in the caustic potash when melamine is prepared. It may be separated by saturating the alakali with an acid. It is best to employ acetic acid, because the mineral acids dissolve in it excess. Carbonate of ammonia and sal-ammoniac precipitate it also from its alkaline solution. After precipitation it should be washed and dissolved in nitric acid. Concentrate the solution and long four-sided colourless or slightly yellow prisms will be separated; or precipitate it from its solution in nitric acid by means of caustic ammonia, or carbonate of ammonia.

AMMELINE—Is a white shining crystallized substance when precipitated by ammonia, insoluble in water, alcohol, and ether, but soluble in the caustic alkalies and in most of the acids. When heated it affords a crystallized sublimate of ammonia, and, if the heat is carried far enough, is coverted into cyanogen and azote, leaving no residue. Towards acids it acts as a base, but it is weaker than melamine. Its salts are partially decomposed by water. Ammeline, analyzed by oxide of copper afforded Carbon 28·553 Azote 55·110 Oxygen 12·451 Hydrogen 3·884 Total 100·000

Nitrate of ameline consits of

1 atom	ammeline	16·
1 "	nitric acid	6·75
1 "	water	1·125
		23·875

Nitrate of ammeline affords with nitrate of silver, a precipitate of the same nature as that produced by melamine, being white and crystalline, and consisting of one atom each of ammeline, nitric acid and oxide of silver. Liebig explains the formation of ammeline and melamine, by considering that from 2 atoms of melam and the elements of 2 atoms of water, 1 atom of melamine and 1 atom of ammeline result.

By boiling melam with hydrochloric acid, ammeline and ammonia are produced by the aid of 2 atoms of water. Cyanate of potash is produced by action of potash on dry ammeline, the cyanic acid in this case being formed by 1 atom of ammeline combining with 2 atoms of water, the resulting product being 3 atoms of acid.

5. AMMELIDE results from adding alcohol to a solution of melam or melamine in concentrated sulphuric acid. It precipitates in the form of a thick white precipitate. It may be also obtained by heating nitrate of ammeline till the soft mass becomes solid, or by boiling melamine in concentrated nitric acid. By boiling impure melam in dilute sulphuric acid, it disolves, and crystals of sulphate of ammeline appear by evaporation, which are decomposed, if the liquid is boiled or further concentrated. Ammelide precipitates by the addition of the alkaline carbonates or alcohol. It is a white power and seems a neutral body. Its composition corrected by theory is, Carbon 28·444 Azote 49·410 Oxygen 18·606 Hydrogen 8.538 Total 100·000.

Liebig considers that it presents an anhydrous cyanate of ammonia or urea, which is deprived of all its water and the half of it ammonia. It is remarkable, that among the transformations of melamine, its saturating properties seem to diminish in proportion to the quantity of oxygen with which it combines. The same observation is applicable to vegetable bases, as for example, narcotine and solanine whose base functions are not well characterized, but which are distinguished from the stronger bases by containing a greater proportion of oxygen.

6. CYANILIC ACID.—If the yellow powder which is obtained from the decomposition of sulpho-cyanodide of potassium by chlorine, and which is mixed with chloride of potassium, be well washed and boiled with nitric acid, it dissolves gradually, and the liquid on cooling deposits colourless and transparent octahedrons with a square bass, which consist of pure cyanilic acid. To accelerate the decomposition of the salt of potash, it is advantageous to add twice its weight of common salt. At first chloride of sulphur distils over, and latterly long needles of chloride of cyanogen are deposited in the neck of the retort. The yellow residue is carefully washed and dissolved in nitric acid. The new acid is more easily soluble in cold water than cyanuric acid. The crystals contain water which they lose by heating, to the amount of 21 per cent. Its composition is, Carbon 28·185 Azote 32·640 Oxygen 36·874 Hydrogen 2·300 Total 100·000 which Liebig considers equivalent to 6 atoms of each. To determine the atomic weight of the acid, a portion was neutralized by ammonia, and precipitated by nitrate of silver. 93·3 cyanilate of silver afforded 54·5 chloride of silver. 58·2 after being exposed to a red heat, left 26·4 silver. Hence, the atomic weight of the acid is 16·25 or double that of cyanuric acid, which it very much resembles in its properties. Cyanilic acid is converted into cyanuric acid by dissolving it in sulphuric acid, adding water and crystallizing. All the cyanurates and cyanilites are decomposed when they are crystallized in an acid liquor; the bases remain in solution, and the crystals which are formed are cyanuric acid or cyanilic acid. In precipitating the nitrate of silver by cyanilate of potash, Liebig obtained a substance which had precisely the same composition as cyanurate of silver, from which it would appear that the alkalies can change cyanilic into cyanuric acid.

7. CHLORIDE OF CYANOGEN.—During the decomposition of sulpho-cyanodide of potassium by chlorine, besides chloride of sulphur, chloride of cyanogen distils over, which may be separated from the former by sublimation in a vessel through which a current of dry chlorine is passed. Chlorine of cyanogen thus obtained consists of brilliant needlees, possessing a strong disagreeable odour. To determine the quantity of chlorine, the salt was dissolved in alcohol, ammonia was added, and the liquid boiled with a great quantity of water until all the spirit was volatilized.

Nitric acid was then added in excess, and precipitation produced by nitrate of silver. The composition of the chloride of cyanogen was in this manner determined to be Chlorine 57·03 Cyanogen 42·97 Total 100·000 or equal atoms of chlorine and cyanogen. Chloride of cyanogen dissolves in absolute alcohol without alteration.

8. CYANAMIDE.—If chloride of cyanogen is moistened with ammonia, and gentle heated, it loses its crystalline form, and is reduced to a white powder, which is slightly soluble in boiling water, and is precipitated on cooling in flocks. The same substance is obtained by passing ammoniacal gas over chloride of cyanogen in powder. A white powder is the result which may be purified by washing. The chlorine which it contains is not removed by ammonia. Potash disengages ammonia from cyanamide. Liebig considers it analogous in its composition to oxamide, and to a chloride of cyanogen.

URIC ACID.—Liebig states that he was encouraged to make the preceding researches in the hope of finding a new combination which would throw some light upon the composition of uric acid. Liebig considers the determination of Dr. Kodweiss, with respect to the proportion of azote, to be nearer the truth than any other. He himself makes the composition of uric acid :

	Calculated.		Experiment.
Carbon	36.11	-	36·073
Azote	33·36	-	33·361
Oxygen	27·19	-	28·126
Hydrogen	2·34	-	2·441

METHOD OF PROCURING OXIDE OF CHROMIUM IN CRYSTALS.—Wöhler has found that the green oxide of chromium, which is well known as a green powder, may be obtained in the state of crystals by passing the vapour of chloro-chromic acid through a red hot glass tube.* A mixture of chlorine and oxygen is formed, and the crystals of oxide are deposited in the tube. Thus prepared, it is not green but black, possessing the metallic lustre, and has the same form as native peroxide of iron, (*fer oligiste* or rhombohedral iron ore) which he considers a proof of the ismorphism of these two oxides. The spec. grav. in the crystallized state differs little from that of peroxide of iron, being 5·21.

It scratches rock crystal, hyacinth, and cuts glass. In the crystallized state it is therefore as hard as corundum, which, with the exception of the diamond and rhodium, is the hardest of known substances. Chloro-chromic acid was discovered by Professor Thomson in 1824, and is prepared by distilling in a glass retort 500 gr. sulphuric acid, with 190 gr. dry bichromate of potash, and 225 gr. of decripitated common salt. According to Dr. Thomson, it consists of one atom chlorine, and one atom chromic acid. Rose considers it a combination of two atoms chromic acid and one perchloride of chromium. Wöhler prepares it by distilling ten parts common salt, 16·9 neutral chromate of potash, and thirty parts of concentrated sulphuric acid.—Record General Science, 1835.

ALCOHOL AND ITS COMPOUNDS.†

1. Aldehyde, (from *alcohol dehydrogenatus*,) may be prepared by passing vapour of ether through a long glass tube filled with pieces of glass heated to redness. The product, according to Liebig, is aldehyde, an inflammable gas, and water, with a slight deposit of charcoal. By passing this product into a vessel, half

* Ann. de Chim. lvii. 105.

† Ann. de Chim. et de Phys. lix. 289.

filled with ether, the aldehyde is retained in solution. If ammonia passed through a tube filled with fused potash and quicklime, is allowed to saturate the ether, the sides of the vessel are speedily covered with brilliant crystals, which are compounds of aldehyde and ammonia. Aldehyde may be also procured by distilling four parts of spirit of wine, six parts peroxide of manganese, six of sulphuric acid, and four of water. The receiver must be kept very cool, as aldehyde is extremely volatile. The process should be stopped whenever the product becomes acid, which happens when six parts have come over. This product mixed with its weight of chloride of calcium, is distilled to three parts. The three parts are again rectified with their own weight of the chloride, when the resulting product is free from water and alcohol. It should then be mixed with twice its volume of ether, and saturated with a stream of ammoniacal gas, taking care to cool the receiver and to place between the vessel supplying the ammonia, and the ether vessel, a safety jar, so as to avoid the danger from the rapid absorption: Crystals speedily appear, which, when purified by ether, consist of ammonia and aldehyde, and are termed by Liebig, *ammonial dehyde.* The same compound may be obtained by passing chlorine through dilute alcohol, distilling and rectifying over chloride of calcium, and saturating with ammonia. A considerable quantity of aldehyde is also formed by the action of spongy platinum upon the vapour of alcohol, as ascertained by Döbereiner. Aldehyde is easily prepared, from its ammoniacal combination, by dissolving two parts of the compound in its weight of water, and heating it, mixed with three parts of sulphuric acid and four of water, in a retort over a water-bath. The product is hydrous aldehyde, which is rectified over chloride of calcium. It is necessary to cool the vessel when these two substances are brought in contact; because, much heat is disengaged, and the aldehyde boils, when re-distilled, at a temperature of 86°.

It is a colourless liquid, limpid like water; very volatile; sp. gr. ·790; boiling point, 71°¾ at 28·82; smell ethereal and peculiar. When its vapour is respired the power of breathing the air for some seconds is lost. It mixes in all proportions with water. It inflames readily. When mixed with spongy platinum, acetic acid is formed. It dissolves sulphur, phosphorus, and iodine, but without altering them, chlorine and Bromine are converted into muriatic and hydro-bromic acids. With nitric acid, acetic acid is formed; with potash a reddish-brown resin is formed, which Liebig designates by the awkward name of *Aldehydharz.* When aldehyde is heated with water and oxide of silver, the latter is reduced, and covers the inside of the tube with a metallic coat. Aldehyde consists of

Carbon 55·024 Oxygen 35·993 Hydrogen 8·983

The density of its vapour is, by experiment, 1·532, which corresponds with

2 vols.	vapour of carbon	..·8333	= 1·5	
2	,, hydrogen ·1388	..·1388	= ·25	
½	,, oxygen	..·5555	= 1·	
		1·5276	2·75	

Liebig gives its formula C_4H_8O.

Ammonialdehyde crystallizes in acute rhombohedrons. The crystals are colourless, possess a hardness equal to sugar, and a smell like that of ammonia and turpentine; they are volatile; inflammable; melt between 158° and 176°. They have an alkaline re-action; they dissolve readily in water, with greater difficulty alcohol, and with difficulty in ether. With the acids and alkalies they act like aldehyde and consist of Carbon 39·700 Oxygen 25·969 Azote 22·987 Hydrogen 11·342

100·000

This is equivalent to

1 atom aldehyde, C_2H^2O = 2·75
1 atom ammonia NH^3 = 2·125

1 atom ammonialdehyde ... 4·875

Inflammable Gas.—The gas which comes over with aldehyde burns with a clear flame. It consists of carbon, 82·3; hydrogen, 17·6.

When heated with perchloride of antimony (readily formed by passing chlorine through fused *butter* of antimony) olefiant gas was condensed in the form of the well-known oily chloride, and the remaining gas possessed all the properties of carburetted hydrogen.

The products of the distillation of alcohol, sulphuric acid and peroxide of manganese, are carbonic acid, formic acid, acetic acid, aldehyde, and traces of ether.

With spongy platinum alcohol is converted into acetal, aldehyde, acetic acid, and acetic ether.

Resin of Aldehyde is formed by the action of potash upon aldehyde. When the latter is introduced into a liquid containing aldehyde, a brown colour is produced, and speedily brown flocks fall, when a weak acid or water is added. They consist of carbon, 73·340; oxygen, 18·900; hydrogen, 7·759.

Aldehydic Acid.—When oxide of silver is heated with a solution of aldehyde a soluble salt is formed, which is not an acetate, and is permanent when evaporated. This salt, when mixed with barytes water, is decomposed, giving off oxide of silver, and, when heated with the salt of barytes formed, produces pure acetate of barytes, and no other products: the oxide of silver being completely reduced. A similar result is obtained by the action of ammonialdehyde upon oxide of silver.

From Liebig's experiments it appears that the formula of aldehydic acid is, $C^4H^3O^2$, and, therefore, a true acetous acid; the compostiton of acetic acid being $C^4H^3O^3$. He considers the lampic acid of Daniell to be identical with aldehydic acid. The combinations may be explained in two ways, according to Liebig:

1st, Aldehyde may be considered as alcohol deprived of an atom of hydrogen, and alcohol as a hydrate of ether; or, 2nd, Aldehyde may be a deutoxide of binolefiant gas. The formulæ will, therefore, be,

1st, Unknown compound of carbon and hydrogen.. .. C^4H^3
Aldehyde.. .. .. .. C^4H^3O + HO
Aldehydic acid .. .. $C^4H^3O^2$ + HO
Hydrous acetic acid $C^4H^3O^3$ + HO

2nd, $C_4 H_4 + O$ oxide of binolefiant gas.
$C_4 H^4 + O^2$ aldehyde.
$C^4 H^4 + O^3$ aldehydic acid.
$C^4 H^4 + O^4$ hydrous acetic acid.

ON THE ACTION OF FLASHES LIGHT UPON RAPIDLY ROTATING DISKS.

By Charles Tomlinson, Esq.

Professor Wheatstone, I believe, first announced the beautiful fact " that a rapidly moving wheel, or a revolving disk on which any object is painted, seems perfectly stationary when illuminated by the explosion of the electric jar."

This experiment is adduced by Mr. Wheatstone, to shew that the duration of electric light embraces a point of time so extremely minute that the revolving wheel, or disk, has not time to pass through any perceptible space, and that, therefore, it appears, during the illumination, stationary; I find, however, that the effect is not confined to electricity, but may be produced by any very sudden flash of light.

Of the disks that I employed I need only mention two: The first, six inches in diameter, was divided into sixteen parts, painted, alternately, red and black; on the second disk, of the same size, were painted in large characters the words, at rest on white ground. Both disks were connected with a small multiplying arrangement.

The effects can be produced with phosphuretted hydrogen, exhibited in bubbles from phosphuret of lime, in water. When the bubbles come up slowly without interrupting each other, both disks appear stationary during rotation; but when the bubbles come up too quickly, the black and red spaces exhibit a dancing sort of motion, and sometimes two black spaces seem joined into one, to the exclusion of the intervening red, and vice versâ; so also with the second disk, the words cross each other in various directions when the flashes of light interfere with each other; and, in both cases, confusions, of course, excited when an impression is made on the retina before succeeding impressions have departed. Similar confused effects are produced with a stream of electricity instead of the discharge; as also by the rapid succession of sparks from a magnet, but in any case when the flash of light is distinct and sudden, the effect is complete.

Soap bubbles, blown with hydrogen or the mixed gases, and fired by means of a filament of cotton passed through a small tube, and wetted with alcohol; gunpowder, done up in the form of a boy's cracker; fulminate of mercury struck on an anvil, may all be successfully employed.

These experiments were performed in a darkened room, not of necessity, but the results are best observed in this manner. In Mr. Wheatstone's experiment, the presence of light, either natural or artificial, does not interfere with its success.

The experiment may be made to succeed by the flame of a lamp or candle. In order to effect this I employed a disk of pasteboard, twelve or thirteen inches in diameter, with a narrow slit cut out, extending from the centre nearly to the circumference, and connected with a multiplying arrangement. The light of the lamp was condensed by a lens, and thrown upon the back of the slitted disk, and the black and red disk placed in the front of the former, so as to receive a flash of light from the lamp every time the slitted disk performed one revolution. On causing both disks to revolve, the black and red spaces were distinctly brought out, assuming, however, a curved form.

But, perhaps, the most convenient method of producing this phenomenon, is to stand behind the slitted disk, while in front of it, at the distance of two or three feet, the radiated disk is made to rotate. On rotating the slitted disk the effect is very complete. The radii are, however, curved either *upwards* or *downwards*, according as the eye of the observer is *above* or *below* the axis of the disk, except the radii which, for the time being, are vertical to the axis above and below, and these are not curved. This effect takes place when the disks are revolving in the same direction. The order will be inverted, if the disks move in opposite directions; a change also will take place in the direction of the curvature of the radii, according to the angle at which the eye is placed.

This experiment is somewhat analogous to one by Dr. Roget, " when a carriage wheel, rolling along the ground, is viewed through the intervals of a series of vertical bars, such as those of a palisade, or of a Venetian window blind. Under these circumstances, the spokes of the wheel, instead of appearing straight, as they would naturally do if no bars intervened, seem to have a considerable degree of curvature." (Phil. Trans. 1825.)

It was found that " the velocity of the wheel must not be so great as to prevent the eye from following the spokes as they revolve." So that Dr. Roget's experiment relates simply to the curvature of the spokes of a wheel seen through a narrow aperture; and he accounts for this fact by assuming the deception to arise from separate parts only of each spoke being seen at the same moment; the remaining parts being concealed from view by the bars. He also found that " when the disk of the wheel, instead of being marked by a number of radiant lines, has only one radius marked upon it, it presents the appearance, when rolled behind the bars, of a number of radii, each having the curvature corresponding to its situation, their number being determined by that of the bars which intervene between the wheel and the eye. So that it is evident that the several portions of one and the same line, seen through the intervals of the bars form on the retina, the images of so many different radii."

My experiment differs from that of Dr. Roget, inasmuch, that the red and black disk may be made to revolve with very great rapidity, by which the black is lost to the eye, and the red alone reflected, slightly diluted with black. The effect of viewing this disk during rotation through the rotating slitted disk, is to decompose the former, and presen

the black and red spaces as distinctly as when at rest, except that the spaces are curved, and, under certain circumstances, increased in number.

If a white disk be employed, with a single black space passing from the centre to the circumference, and occupying about 20° of the latter, the effect will not be as in the case of the disk of the wheel with only one spoke giving the appearance of a complete wheel, as in Dr. Roget's experiment, but the black space will be brought out in a curved form, and sometimes divided into two.

If a disk, composed of two semi-circles, one white and the other black, be viewed, while in motion, from behind the revolving slitted disk, the diameter of the disk will vibrate on both sides, the centre being fixed; the white gaining upon the black and the black, upon the white, and so on, alternately.

The cause, then, of the appearances detailed in the first part of this paper, is the same as in Dr. Wheatstone's experiment, the light comes and goes before the disk has time to move through any sensible space; but, in the experiments where the light of a lamp flashes upon the painted disk through the slitted disk, or where the eye is placed behind the slitted disk, the duration of the light is greater than the electric light, or than that from phosphuretted hydrogen, &c., and the disk *does* pass through a sensible space. Now, as the circumference of the disk moves quicker than the centre, that is, the velocity decreases from the circumference to the centre, a black space, for example, seen at one point of the circumference, will have moved through several degrees as the slit pases the eye; while, at or near the centre, the space gone through is barely appreciable. This, together with the persistance of impressions on the retina, added to that which is said above, will, I think, account for the revival of the radii, as also for their curvature; and the rapid succession of black and red spaces will account for the apparent increase in their number.

If the distance between the two disks be considerable, fourteen or fifteen feet, for instance, the curvature of the radii will be corrected, and their number will not be augmented; because, a full view of the disk is thus obtained, and the relative velocities of the centre and circumference compensated by an impression of the whole of the disk being formed upon the retina.

Salisbury, 18*th November*, 1835.

ON THE METHOD OF DETERMINING THE PROPORTIONS OF POTASH AND SODA, WHEN THE TWO ALKALIES ARE MIXED TOGETHER.

By Thomas Thomson, M. D., F. R. S. L. and E., &c. Regius,

Professor of Chemistry in the University of Glasgow.

It is no uncommon thing to meet with minerals which contain both potash and soda as constituents. This is the case, for example, with glassy felspar, couzeranite, &c. The method of separating the two alkalies from each other, in such cases, is that first pointed out by Dr. Wollaston. All the other constituents of the mineral being seperated, the potash and soda are united to muriatic acid, or converted into chlorides of potassium and sodium. These chlorides being dissolved in water, are mixed with a solution of chlorid of platinum. The mixture is evaporated to dryness in a gentle heat, and then digested in a sufficient quantity of weak alcohol. The chloride of sodium, and any excess of chloride of platinum that may have been added are dissolved, while the potassium-chloride of platinum remains undissolved. Separate it by the filter, wash it and dry it; the potash contained in the mineral amounts to $\frac{3}{13}$ths, or 0·23 of the weight of this double salt. The weight of the potash being known, and likewise the weight of the two chlorides of potassium and sodium, it is easy to deduce that of the soda.

I consider the following method easier than this, especially when the quantity of potash and soda to be separated is considerable, and I have found that young analysts learn very soon to employ it with accuracy.

1. Convert the mixture of potash and soda into sulphates, render these sulphates anhydrous by ignition in a platinum crucible, and determine their weight. Let it amount to 29 grains.

2. Dissolve the two sulphates in water, and throw down the sulphuric acid by chloride of barium. Wash the sulphate of barytes obtained, dry it and weight it after ignition. Let the weight be 43·5 grains, indicating 15 grains of sulphuric acid.

3. Separate any excess of barytes that may have been added to the liquid by the cautious addition of dilute sulphuric acid. Filter, evaporate to dryness and ignite. The salt thus obtained will consist of the mixture of potash and soda converted into chloride of potassium and sodium. Weigh this salt. Let the weight be 24·5 grains.

Now, the atom of potash is 6, and that of soda 4; and it is obvious from paragraphs 1 and 2 that the mixture of potash and soda weighs 14.

Let the atoms of potash in the mixture be x, and those of soda y, it is plain that we have

$$6x + 4y = 14 \text{ and } x = \frac{14 \cdot 4y}{6}$$

By comparing paragraphs 3 and 4, it is obvious, that the weight of chlorine in the 24·5 grains of the mixed chloride obtained is 13·5 grains. For it must be equivalent to the 15 grains of sulphuric acid. In this mixed chloride the potash is converted into potassium, and consequently its atom weighs only 5, while the atom of sodium weighs 3. We have, therefore

$$5x + 3y + 13 \cdot = 24 \cdot 5 \text{ and } x = \frac{11 - 3y}{5}$$

If we equate these two values of x we have

$$\frac{14 - 4y}{6} = \frac{11 - 3y}{5}$$

By solving this equation, we obtain $y = 2$. From which we deduce $x = 1$.

Thus, it appears, that in the supposed mixture there were 6 grains of potash and 8 grains of soda.

The numbers in the preceding example were made as simple as possible, that the nature of the process might be understood at a glance. But it may be worth while, for the sake of those analysts who are not familiar with algebraic computations, to give a general formula, and then explain it by simple arithmetic.

Let the atoms of potash be .. x
,, ,, soda .... y
Let the weight of sulphates be . a
,, ,, sulphuric acid b
,, ,, chlorides . . c
,, ,, chlorine . . d

$$y = \frac{5a + 6d - 5b - 6c}{2}$$

$$x = \frac{a - b - 4y}{6}$$

Add together five times the weight of the sulphates and six times the weight of the chlorine. From this sum, subtract five times the weight of the sulphuric acid and six times the weight of the chlorides. Divide the remainder by two; the quotient represents the number of atoms of potash in the mixture. This number multiplied by six gives the grains of potash present.

If we subtract the weight of the potash from the weight of the mixture of potash and soda, determined by paragraphs 1 and 2, the remainder will be the weight of the soda, present in the mixture.—*Records of General Science.*

GASTRIC JUICE.

The experiments of Dr. Prout. and of Tiedemann and Gmelin in reference to the gastric juice, are confirmed by those of Braconnot, and prove that there is no peculiar substance to which this appellation should be applied, but that the remarkable peculiarity of the stomach is the property which it possesses of secreting a great quantity of muriatic acid. The gastric juice examined by Braconnot was obtained from a dog. He found it to contain. 1. Free muriatic acid in great abundance. 2. Muriate of ammonia. 3. Chloride of sodium in very great quantity. 4. Chloride of calcium. 5. A trace of chloride of potassium. 6. Chloride of Iron. 7. Chloride of magnesium. 8. Colourless oil with an acid taste. 9. Animal matter soluble in water and alcohol, in very considerable quantity. 10. Animal matter soluble in weak acids. 11. Animal matter soluble in water, and insoluble in alcohol (salivary matter of Gmelin). 12. Mucus. 13. Phosphate of lime. He found no trace of lactic acid.—(*Annales de Chimie,* lix. 348.)

BENZOYLE, BENZIMIDE, AND BENZOINE.

In distilling the essence of bitter almonds with well water, Laugier obtained a resinous substance which Laurent found to consist of 1. An oil containing the essence of bitter almonds; 2, benzoine; and 3, a crystalline body which he terms benzimide. Boiling alcohol dissolves the oil and benzoine, and on cooling benzimide falls. After filtration, by evaporation, the bezoine crystallizes and the oil remains in solution. The benzimide and residue are dissolved in boiling alcohol, and on cooling minute needles of benzimide separate.

Benzimide is white and destitute of smell, insoluble, very little soluble in boiling alcohol and ether. When heated, it burns with a red flame, leaving a brown residue. Nitric and muriatic acids dissolve it readily. Sulphuric acid dissolves it and acquires an indigo colour. When treated with pieces of potash and some drops of alcohol, benzoate of potash is formed.

It consists of carbon 74·86; hydrogen 4·94; oxygen 13·20; azote 7. This composition Laurent considers equivalent to bibenzoate of ammonia, with a deficiency of 4 atoms of water, or we may call it $C14\ H5\frac{1}{2}\ O\ N\frac{1}{2}$. The benzamide of Wöhler and Liebig corresponds with the neutral benzoate of ammonia.

Benzoine was previously obtained from the essence of bitter almonds from which it may easily be extracted by means of potash. It consists of carbon 78·652; hydrogen 5·772; oxygen 15·577. This corresponds with C14 H6 O, and is isomeric with hydret of benzoyle.

Benzoyle was formed by passing chlorine over fused benzoine. The product was dissolved in alcohol, and crystallized. Benzoine is yellowish, insipid, insoluble in water, soluble in alcohol and ether. Crystals six-sided prisms, terminated by summits with three pentagonal faces. They burn with a red flame. Hot sulphuric acid dissolves them, and water precipitates them from the solution. Potash when dissolved in water does not alter them, but when an alcoholic solution is imployed, a fine colour of turnsol is produced. If this solution is evaporated, a salt is obtained which forms with sulphuric acid a beautiful pink solution. Benzoyle consists of carbon 80·43; hydrogen 4·91; oxygen 15. This Laurent considers is represented by C14 H5 O. Hence, we see that the chlorine has removed an atom of hydrogen.—(*Ann. de Chim.* lix. 397).

OBSERVATIONS ON THE FORMATION AND CHANGES OF THE INFERIOR ORDERS OF PLANTS. By F. J. Kutzing.*

The nature of the lowest species of plants is a subject of interest. M. Kutzing, from many observations which he has made upon them, has drawn some important results.

Distilled water remained stationary for six months, without shewing any appearance of green matter on its surface. Water which had been distilled over plants presented a different aspect.

In some of them a mucus began to shew itself in the course of eight days; in rose water in about two weeks. First the mucus

* Ann. des Scien. Nat. II. 129.

is deposited, and the characteristic odour of the water disappears. Hence, this mucilage would appear to be formed at the expense of the essential oil. No filaments or globules can be discovered at this stage; but if the water is less exposed to the direct influence of the sun, they appear at first colourless in the mucus mass, and then the different forms of *Hygrocrocis Leptomitus* shew themselves. This constitutes the second step; the light of the sun determining whether *Protococcus* or *Hygrocrocis* shall be developed. The lowest state of these globules is well exhibited in the genus established by Kutzing, of *Cryptococcus* which is inferior to *Protococcus*; for in the former the organic mucus is only observed in the form of minute globules, while in the latter, they are larger and possess colour with a more solid texture. The third step is the formation of filaments, by the union or elongation of the colourless globules, giving origin to *Hygrocrocis* or *Leptomitus*. The *L Plumula* is an advanced state of *Cryptococcus*. The latter is formed in moist windows. Kutzing has observed the formation of an *Oscillatoria* which he calls *fenestralis*, over a stratum of *Cryptococcus*, which previously became a *Palmella*. If we term the transformation of *Cryptococcus* into *Hygrocrocis* and *Leptomitus* a direct progressive step, we may call that of *Cryptococcus* into *Palmella* and *Protococcus*, litterally progressive.

It is a worthy of remark, that the *Protococcus* is often found in dry places, for it seems that it never appears in water except when the sun is shining on it, and the *Hygrocrocis* and *Leptomitus* appear in the shade. It has been observed that the algæ (olgues) are formed after the death of the *Infusorii*, especially the *Enchelys Pulvisculus*. When the water in which this animal is found, is evaporated, the latter contracts after death into globules. These possess at first their transparency at the extremities, which correspond to the head and tail; but gradually they contract into a ring surrounded by other globules, and assume an appearance resembling *Protococcus*; only it is mucilagenous when united in large masses, and is therefore more like *Palmella*.

At this time an *Oscillatoria* begins to appear, which Kutzing terms *brevis*. It is always the same plants. The author confirms the accuracy of the observation of Treviranus with regard to the motion of the sporules of algæ. He observed the motions of millions of globules while examining the *Draparnaldia Plumosa* in a glass of water. Under the microscope he noticed, that as the green border (which was formed on the second day after depositing the plant in water), increased, the filaments of the *Draparnaldia*, lost their green colour and became hyaline, and the globules resembled then the *Cymbella* (Frustulia.) These movements somewhat resemble those of pollen in spirit of wine, camphor in water, &c. but they are of longer duration. By keeping a *Protococcus* which was seated on sandstone constantly wet, the globules became connected, filaments were formed, and a conferva produced, which he calls *tenerrima* (*C Muralis* Spreng.) This plant is found in the waters of reservoirs, and is transformed into an alga of a superior order, the *Inoderma*. Kutzing observed the *Alysphæria flavo-virens* to be produced from the *Protococcus viridis*, by the conversion of the globules into dichotomous filaments.

He found likewise, that by examining the structure of the *Parmelia sparietina*, it is observed, that the globules of the *Protococcus viridis*, which occurs on trees along with the lichen, enter into its frond, and that the latter is the first state of the lichen. Upon the upper part of trunks of trees, we observe the *Parmelia parietina*. At the base we notice filaments of *Protonema*, which are generally converted into *Orthotrichum*, *Hypnum* and other mosses.

Kutzing has distinctly observed these threads of *Protonema* formed by globules of *Protococcus*. These globules swell, being filled in the interior with a green liquid, and are gradually expanded into filaments. It appears that the formation of *Alysphæria* does not necessarily precede that of the lichens, but that it is an independent structure. Kutzing observed the *Barbula muralis* a moss, produced from *Protonema* and also from a *Protococcus*. The genera *Zygnema* and *Mongeotia* are generally found in shallow water. When the water containing these plants is evaporated, the *Conferva quadrangula* appears. From the *Mongeotia genuflexa* in this way proceeds the *Riccia crystallina*.

From his observations Kutzing infers :—

1. The formation of organic matter cannot take place, except from elements of other organic principles already dissolved

2. Simple globules (*Cryptococcus*, *Palmella* and *Protococcus*), may produce different plants according to the influence of light, air and temperature.

3. The superior algæ are plants of very simple structure.

4. The same superior structure may be produced from original structures altogether different. Thus, the *Barbula muralis*, is formed from the *Protonema* which comes from a *Protococcus*, and again proceeds from the remains of the dried *Palmella botryoides*, without passing through the stage of *Protonema*.

PROCEEDINGS OF THE ASHMOLEAN SOCIETY, OF OXFORD, 1836-

June, 26, 1835—The following query was proposed by a member:

In what way can we satisfactorily explain the mode in which spiders carry their threads from one object to another at considerable distances through the air?

DR. DAUBENY EXHIBITED A SPECIMEN OF THE BROMELIA PINGUIS.—A native of the West Indies, which flowered this autumn in the open air in the garden of Mr. Shirley of Eatington Park, near Shipston-upon-Stour. This plant has rarely blossomed in Europe even under glass, although a drawing of it in flower is given in the Hortus Elthamensis; and the individual plant alluded to had been tried first in the pinery, and afterwards in the greenhouse, but had never put forth flowers, till it was taken

out of doors, when it flowered, though the petals, never, properly expanded.

A COMMUNICATION WAS ALSO READ BY HIM RESPECTING AN ELECTRICAL PHENOMENON STATED TO HAVE OCCURRED IN THE GARDEN OF THE DUKE OF BUCKINGHAM, AT STOWE.—The following was the statement drawn up by his Grace's direction, of the circumstance alluded to.

"On the evening of Friday the 4th of September, 1835, during a storm of thunder and lightning, accompanied by heavy rain, the flower called *œnothera macrocarpa*, a bed of which is in the garden immediately opposite the windows of the manuscript library at Stowe, were observed to be brilliantly illuminated by phosphoric light.

"During the intervals of the flashes of lightning, the night was exceedingly dark, and nothing else could be distinguished in the gloom except the bright light upon the leaves of these flowers.

"Stowe, September, 23rd, 1835."

A PAPER WAS READ BY PROF. RIGAUD ON HALLEY'S ASTRONOMIÆ COMETICÆ SYNOPSIS.—Halley had begun his calculations of cometary orbits in 1695, and appears to have completed them in 1702; but it was not till 1705 that he published his Astronomiæ Cometicæ Synopsis in the Philosophical Transactions for 1705. In this he gives the parabolic elements of 24 comets observed between 1337 and 1698, with the table which he formed for calculating their motions. This he re-printed separately at Oxford in the following summer; and an English translation was published the same year, which probably was his own, as he adopted it in the second volume of the Miscellanea Curiosa. The Synopsis was intended for the introduction to a larger work, and he printed it to secure his calculations from being lost, in case of any accident befalling him. The first edition contains a notice of some similarity (on which, however, he did not much depend) between the comets of 1661 and 1532, whose possible return in 129 years has not been verified. In 1715 the work was re-printed at the end of an English translation of Gregory's Astronomy. In this he first speaks of calculating the elliptical orbits, and brings forward the possible identity of the comets of 1105 and 1680. In 1719, with his volume of Astronomical Tables, he printed a new edition of the Synopsis, in which he entirely omits the mention of the comets of 1661, but gives elliptical elements for those of 1680 and 1682, and a comparison of the places calculated from them with the observations which he could find on record. He had likewise discovered some earlier observations of the last, which agreed well with its revolving in an orbit of about $75\frac{1}{2}$ years; and having pointed out the circumstances which retarded its return, he confidently concluded that it might be expected again in the latter end of 1758 or 1759.

MR. KYNSTON EXHIBITED, AND PRESENTED TO THE SOCIETY, A PRESERVED SPECIMEN OF A GRASSHOPPER.—To which were attached a number of species of worm, very long, slender, and convoluted which had fixed themselves upon it, and destroyed it. It was found in Switzerland.

THE PRESIDENT SHEWED A PORTION OF WASP'S NEST MADE IN A HOLLOW IN A SUGAR-LOAF.—Into which the wasps had eaten, and composed of the blue and white paper in which the loaf was wrapped. The nest was discovered in the month of August, and appeared to have been begun not long before. No instance being as yet known of wasps going out from a nest already formed to construct another in the same year, it is most probable that the present nest was begun by a female wasp, which had survived the last winter, and not by any of the other wasps which were engaged in eating the sugar.

DR. DAUBENY STATED THAT DURING THE LAST AUTUMN HE HAD MADE THE DISCOVERY OF FRESH SPRINGS WHICH EVOLVE NITROGEN GAS.—The first of these was the tepid spring of Mallow in the county of Cork, a water which contains but very little solid matter. The gas evolved consisted of

Nitrogen 93·5. Oxygen 6·5.

It appears to issue from carboniferous limestone, the beds of which in its immediate neighbourhood are vertically disposed, intimating that they have been affected by some violent action since they were originally deposited.

The other spring, disengaging nitrogen, which he observed, was near Clonmell. It was a very clear but perfectly cold water, called St. Patrick's well, held in much veneration in the neighbourhood, and resorted to by pilgrims in great numbers. Bubbles of gas rise up through it, which Dr. Daubeny found to cousist of

Nitrogen 94. Oxygen 6.

The spring gushes out of the same limestone stratum, as that of Mallow.

November 20*th*. A NOTICE WAS COMMUNICATED FROM MR. KIRTLAND RESPECTING THE WORM EXHIBITED AT THE LAST MEETING BY MR. KYNASTON, WHICH HAD APPARENTLY DESTROYED A GRASSHOPPER.—It is found to be the *gordius aquaticus*, or hair worm, so called from various contortions and knots into which it twists itself. In a communication made to Loudon's Magazine, vol. ii. p. 211, it is said to be often met with on the surface of garden or other ground in wet weather, as it is in water or clay, its common habitation.

The *gordius aquaticus* is not unfrequently found to inhabit the intestines of insects. *De Geer* (marshall of the court of the queen of Sweden, and member of the Academy of Stockholm, and who published a work intitled "Memoires pour servir á l' Histore des Insectes" in 7 vol. 4to. 1752—1779) mentions these worms being found *in grasshoppers*. Dr. Matthey likewise mentions one of these worms being found in the body of a *grasshopper*, which was no less than $2\frac{1}{2}$ feet in length.

Mr. Paxton mentioned a similar case in the instance of an earwig.

MR. JOHNSON (OF QUEEN'S, READ A SHORT ACCOUNT OF SOME MATHEMATICAL RESEARCHES HE HAD LATELY PURSUED ON OPTICAL IMAGES.—He was led to this remarkable result, that, according to the mathematical theory, the image of a straight line placed vertically in water, and also horizontally, are each the loci of equations of high dimensions and great complexity, and should be curves of high orders, but to the eye they are straight lines; a very accurate construction of the curves, however, shewed that certain portions of them (which properly represent the image) will approach so near to straight lines as to be such to the eye. Drawings of these curves were exhibited.

MR. POWELL GAVE A COMMUNICATION ON THE DISPERSION OF LIGHT.—In continuation of former papers, in which he illustrated the subject by diagrams of the several spectra formed by prisms of water, oil of turpentine, flint glass, oil of cassia, oil of aniseed, and sulphuret of carbon, shewing their comparative refractive and dispersive powers.

DR. BUCKLAND READ A FURTHER STATEMENT RELATIVE TO THE LUMINOUS APPEARANCE ON THE FLOWERS OF THE ŒNOTHERA, MENTIONED AT THE LAST MEETING.—It was distinctly stated that the luminous appearance continued uninterruptedly for a considerable length of time: it did not appear to resemble any electric effect: and the opinion which seemed most probable was, that the plant, like many known instances, has a power of absorbing light, and giving it out under peculiar circumstances.

DR. DAUBENY EXHIBITED SOME SPECIMENS OF SAND AND CLAY FOUND IN THE BOTTOM OF THE CAVERNS.—In limestone, at Michell's town, near Cork. The sand covered the bottom of the cave to an unknown depth, and was itself covered with a crust of stalagmite. The sand must have been washed in through a very narrow entrance; and there is no existing stream capable of so introducing it. No bones or other remains were found in it.

Dr. Buckland also explained the occurrence of such sand, &c. by diluvial action, and proceeded to remark a curious circumstance connected with these caverns. There has never been an instance in which any deposits have taken place at the bottoms of caves, except such as are composed of recent remains, and the mud, sand, &c. of the surface; debris and fossil remains of older formations never occur in them. The only instance known of any older remains in caverns, is that of the caves at Palermo, belonging to the latertertiary period, and containing shells, &c. of that formation perforated by pholades, though now raised 300 feet above the sea.

Dr. Buckland also observed that the origin of caves in limestone had during many years occupied his attention, and has always been considered by him one of the most difficult problems in geology. To a certain degree they have in many cases been the effects of mechanical violence producing lateral movements, and tearing asunder portions of solid rocks, during the elevation, or subsidence, of the strata in which they occur. In cases of this kind, the fractures are usually rectilinear, and partake of the nature of a slip or fault, never filled up. But the lateral enlargements and tubular communications that proceed in various directions from the main apertures, and the vaulted and dome-shaped expansions that occur at irregular intervals along the minor winding passages, cannot be referred to mechanical violence; and an adequate cause of their origin may possibly be found in the influence of acid vapours, (probably carbonic acid,) rising through fractures adjacent to these corroded portions of the limestone.

Caverns in solid limestone could not have been produced, like cells and cavities of various size in beds of porous lava, by air included in the viscid substance of the strata, before or during the progress of consolidation, because they are most abundant in limestones of the most compact character, and in which no other trace of cellular structure is to be found. Moreover, the interior of caverns usually presents an irregular carious surface, similar to that which is produced on a mass of limestone submitted to the action of an acid.

If these supposed acids were mixed with water, the lime thus dissolved would have been removed in a state of solution, and the sides of the caves would be found studded with the less soluble contents of the strata, such as siliceous concretions, and fragments of orgainic remains, standing in relief, as we often see them around the interior of these carious vaultings.

The organic remains in these strata, particularly the corals, are often disposed in such a manner as to shew that considerable time elapsed during the deposition of the successive beds of limestone in which they are enveloped; no accumulations of gas in connected cavernous expansions passing from one stratum into another could have taken place in beds of limestone thus deposited at successive intervals.

Dr. Daubeny expressed a doubt as to whether all caverns could be accounted for by aqueous corrosion alone, and conceived that the large vaulted chambers into which many of them suddenly expand, may have been originally produced by an evolution of gaseous matter, whilst the rock itself was in a softened condition.

OUTLINES OF MINERALOGY, GEOLOGY, AND MINERAL ANALYSIS.

By Thomas Thomson, M. D., F. R. S., &c.

2 *vols. London*, 1836.

There is not any more important result which has emanated from the discovery of the atomic theory than the demonstration that the mineral kingdom consists, not of a multitude of heterogeneous bodies, heaped toge-

her without any method, but that each mineral species which is met with on our globe, is formed of elements definitely combined; and that a cabinet of minerals ought to constitute part of every chemical museum, as essentially, as soluble and other salts which were formerly considered as distinct from the mineral kingdom. This was easily proved, in reference to more simple minerals, whose elements were found to exist, combined in atomic proportions, both in artificial and natural salts. Thus, the atomic weights of sulphuric acid and lime being determined when entering into the composition of what were at first ascertained to be atomic compounds it was but reasonable, on the occurrence of these bodies in a native state, to assign to their ultimate particles the same atomic weights. Accordingly, sulphate of lime has been found abundantly in a native state, in two states,—first, as Cal. Sl. + 2 Aq, and second, as Cal. Sl. In both of these instances the atomic weights of the sulphuric acid and lime were precisely the same as in the more familiar salts, sulphate of soda, muriate of lime, &c. Having ascertained that this held good in regard to one or more minerals, chemists were induced to extend their researches over the field of nature. They gradually discovered that some bodies possess actions which they would have long looked for in vain, if they had neglected this delightful and varied field of investigation. They found that a mineral termed Table Spar, afforded, by the analysis of eight different specimens from different localities, always, the same quantities of silica and alumina,—about 51 parts of the former, and 45 of the letterAnother mineral, Picrosmine, gave by analysis, 56 parts silica and 36 magnesia. What, then, were the legitimate deductions to be drawnfrom these analyses? Was it not correct to say that the silica acted the part of acid to the lime and manganese, as did the sulphuric acid in the instances previously alluded to? Hence the formulæ for table spar and picrosmine, it has been inferred, are Cal. S2 and Mg S2. The discovery that silica acted as an acid, in simple combinations, was sufficient to entitle chemists to conclude that this important body continued to preserve its power of action in more intricate compounds, where several bases presented themselves, upon which it might exercise its agency. If in the case of the table spar, an atom of iron had been present, we should have had Cal. S × FS; the formula would have been extended the composition would have been somewhat more intricate; and, if we had a third atom of silica, as in tersilicate of lime, we might have had a third base united with the third atom of acid And all this with as much propriety as there is in representing the composition of the more familiar salt, alum, by K Sl. + 3 Al. Sl. + 25 Aq.

To those who have occupied themselves with the important study of the mineral kingdom, we know that these observations are quite superfluous; but they may properly be urged in answer to such as term the analysis of stones (as they sneeringly designate the labours of the analyst) an abuse of the atomic theory; and they are peculiarly applicable in turning our attention to the new work on mineralogy and geology, whose title stands at the head of this article. The first volume consists of a description of 509 different species of minerals; the greater proportion of which have been subject to analysis, either by the author himself, or under his superintendence; and those, alone, can judge of the activity and enthusiasm with which, during the last ten years, these labours have been engaged in, who have been employed as fellow-workmen in the delightful, though ardous task. Before a properly arranged system can be formed, the elements of that system must be examined. Not only have the elements been scrutinized in the present instance, but they have been reduced into order, and of such a nature, as, we conceive, infinitely surpasses any which has been previously proposed. By the systems hitherto propagated the most dissimilar bodies have been associated. The classification of minerals, as of salts, should be simple, not complicated. The arrangement in the British Museum belongs to the latter class, and must be pronounced bad. The acids there distinguish the classes, and hence, the greatest confusion is produced; for the salts of each base constitute as many classes as the base forms combinations with acids, Thus lead is found in combination with at least seventeen different acids. These different minerals will, therefore, according to this arrangement, be deposited in seventeen different places. The base, however, of a salt, gives character, generally, to all the bodies into which that base enters as an element; the acid does not afford any such general character. If we class together the different sulphates, for example, we have bodies associated of all hues and dyes; but if we place the salts of copper in juxtaposition, the merest tyro would instantly discover the propriety of such an arrangement. This is the plan which has been adopted in the present work.

Such is a general view of the contents of the first volume. It commences with an introduction explanatory of the nomenclature of the external characters of minerals, and exhibiting a view of the system of crystallography adopted by Mohs, for the purpose of enabling the English reader to consult Haidinger's admirable translation of Mohs' works. The volume concludes with three tables, in the first of which are given the specific gravity, hardness, and form of the crystals of minerals, in the order of the chemical arrangement. The second affords a list of minerals arranged according to the specific gravity, beginning with Scheererite the lightest; and the third supplies a list of minerals in the order of their hardness. Mineralogists will at once appreciate the utility of these tables.

The first 345 pages of the second volume are devoted to an outline of geology, and a valuable and complete table of the fossils, plants, and animals found in the mineral kingdom.

The first chapter, on the Temperature of the earth, is full of most important matter. In

order to determine the state of the question in reference to the existence of a central fire, the author has collected all the observations that have hitherto been published on the temperatures, from the surface of the earth to the greatest depth that has been attained by man. From these it appears that, taking the mean of nineteen ovservations, there is an increase of 1° F. for every 50 feet of descent. This is the evidence which many bring forward for the existence of a central fire. The author, however, shews, that according to the observations of Mr. Moyle, made during a series of years in Cornwall, the high temperature of these mines continues only while they are working. When they are abandoned they are soon filled with water, which remains stagnant, and the temperature gradually sinks, till it approaches that of the mean temperature of the place. 2. That the temperature of the earth is regulated entirely by the sun, for, the higher the sun is elevated above the horizon and the longer it continues above the horizon, the higher is the temperature. If the temperature increased 1° for every 50 feet, a descent of 12 miles or a point by so much nearer the centre of the earth than the position of the equator, should afford a temperature, allowing for radiation, of 1200°. Now, this ought to be the temperature of the poles, because they are 12 miles nearer the earth's centre than the equator. Their temperature is, however,—13°, and hence, this seems a fatal argument to the notion of a central fire. But, although the idea of a *central* fire is not supported by the facts with which we are acquainted, it is not unlikely that an *internal* fire exists, which gives origin to those vast volcanic regions and earthquakes which are continually altering the aspect of the earth's surface. If we were to consider this fire as approaching nearer the surface in some places than in others, we might have, perhaps, an explanation of the relative causes of volcanoes and earthquakes.

The remainder of the geological portion is divided according to the formations, beginning at the surface. Many original observations are detailed, especially in reference to the geology of Scotland, where the occurrence of most remarkable alterations in the relative levels of the sea and land is minutely detailed. The Glasgow coal beds are accurately described. The annual consumption of coal in the Glasgow markets, it is stated, amounts to 870,000 tons. But one of the most curious facts detailed, is the discovery, by the author, of a bed of coal in basalt, near Dalry, in Ayrshire.

This bed is 4 feet thick, and is situated some hundred feet below the summit of Beadlan-hill, which is elevated 903 feet above the sea. Its specific gravity is 1·317. Colour brown; it is very hard. Burns with a lively flame, and leaves 25·77 per cent. of earthy matter. It contains vegetable impressions differing from any that have hitherto been described, as derived from the coal formation. They appear to be *fucoides*. The only other locality, where it is believed, coal has been found in basalt, is at Fairhead, in Ireland, but no fossils have been observed in it.

The latter part of the second volume, consisting of above 200 pages is devoted to rules for the analysis of mineral substances, including stony minerals, metallic alloys, and mineral salts. This portion of the work is worth the attention of geologists as well as mineralogists, as it must be obvious to every one, who casts his eye over the vague speculations of too many of our present geologists, that without the application of chemistry, mineralogy, and natural history, geology is but a name.—*Records of General Science.*

EXAMINATION OF HAIR SALT, OR NATIVE SULPHATE OF ALUMINA AND IRON.

By Robert D. Thomson, M. D.

(Continued from page 122.)

The rock on which the salt lies is a granular schistose quartzose rock of a greenish-gray colour, with small silvery scales of mica, and is impregnated with the salt matter which covers partly the surface with flakes, and partly incrusts it. The flocky portion consists of bitter salt, the crust of alum, with a small quantity of bitter salt. The rock on which the river flows is a granular gray quartz, with some small scales of mica. The roof of the cave consists of red conglomerate, in which rolled quartz occurs, and occasionally pyrites and oxide of iron. The neighbourhood is formed of hills 800 feet high, which are intersected by deep vallies, and capped by limestone. This limestone contains small portions of carbonate of magnesia, with traces of manganese and iron. Fossil oyster, and muscle shells were observed on the upper part of the hill, between Uitenhage and Enon. Hence, it would appear to be a very recent tertiary formation. It is worthy of notice that the alum and bitter salt are formed separately, and that neither of them contain iron, although the oxide of that metal occurs abundantly in the conglomerate. The feather alum, according to Hofrath Stromeyer, is a new hitherto undescribed species of alum, in which the sulphate of alumina occurs in combination with sulphate of manganese and sulphate of magnesia. Hence, he terms it mangan-magnesia alum. Sulphate of manganese has never previously been detected in any species of alum.

At Tschermig, in Bohemia, an ammoniacal alum is found, which, according to Lampadius and Gruner, consists of Alumina 11.602 Ammonia 3·721 Magnesia 0·115

Sulphuric acid 36·065 Water 48·390 Total 9989·3.*

The stalactitical bitter salt of Neusohal, in Bohemia, contains Magnesia 15·314, Oxide of cobalt 0·688, Oxide of copper 0·382, Protoxide of manganese 0·343, Protoxide of iron 0·092, Sulphuric acid 31·372, Water 51·700, Total, 99·891 †

5. The substances which have been already described are all derived from foreign localities. I now proceed to relate the facts which have been ascertained with respect to the hair salts of this country.

Mr. Phillips subjected to examination the salt which proceeds from the decomposition of iron pyrites in the shale of the deserted coal mines of Campsie and Hurlet, in the nighbourhood of Glasgow. He obtained

Sulphuric acid....	30·9	- 3·07 atoms.
Protoxide of iron..	20·7	- 2·3 ,,
Alumina	5·2	- 1·15 ,,
Water	43·2	- 19·2 ,,
	100·0	

The formula deduced from his analysis is

$$2\,f\,S. + Al.^2\,S. + 16\tfrac{2}{3}\ Aq.‡$$

He repeated the analysis, and obtained the sulphuric acid in excess.

The conclusions at which I have arrived, after making several careful analyses, are, that the substance is by no means a steady compound, as I have never obtained the same quantity of alumina, and have found that of the acid to vary considerably. That the latter is often in excess is evident, from the salt tasting sour in many instances, while at other times it is nearly tasteless. Mr. Phillips informs us that he found the proportion of alumina less, in a second trial which he made, than in his first analysis, although the difference was not so considerable as to induce him to repeat his experiments.

The specimens which I examined were from Campsie, and consisted of silky, albestus-like threads mixed with pieces of shale and sulphate of iron, which were carefully excluded before dissolving the salt.

It is very soluble in water, and often possesses a styptic taste, from the presence of minute portions of sulphate of iron; 5 grs. introduced into a platinum crucible, and exposed to the heat of a spirit lamp, lost, without altering in colour, 2·13 grs. By an additional heat, which rendered the salt reddish, 0·03 disappeared. If we suppose that all the water was expelled in the first experiment, without decomposing the compound in any degree, we obtain a per centage of 42·6; by the second we have 43·6.

The following table contains the result of three analyses of hair salt from Campsie:

	Sulphuric Acid.	Protox. of Iron.	Alumina.	Water.
1.	32·925	19·800	2·500	44·775
2.	28·635	19·935	2·850	48·580
3.	33·580	19.620	3·200	43·600
Mean . . .	31·713	19·785	2·850	45·651
Atoms . . .	6·34	4·39	I·26	40·5

In these experiments the composition is,

	First.	Second.	Third.
Sulphuric acid ..	6·5 ..	5·727 ..	6·71 atoms.
Protoxide of iron	4·4	4·4 ..	4·35
Alumina	1·1 ..	1·26 ..	1·42
Water	39·8 ..	43·18 ..	38·75

To represent the composition by these analyses, we have the formulæ respectively:—

$$1.\ 4\,f\,S. + Al.\,S^2 + 36\ Aq.$$
$$2.\ 3\tfrac{1}{2}\,f\,S. + Al.\,S. + 34\tfrac{1}{4}\ Aq.$$
$$3.\ 3\,f\,S. + Al,\,S1\tfrac{1}{2} + 27\tfrac{1}{4}\ Aq.$$

And, as expressing the mean, we may adopt

$$3\tfrac{1}{2}\,f\,S. + Al.\,S1\tfrac{1}{2} + 32\ Aq.$$

Another specimen which had been preserved in a phial for some years was also analyzed, and yielded.

Sulphuric acid..	35·600	- 2.37 atoms.
Protoxide of iron .	13·500	- 1· ,,
Alumina	7·127	- 1·05 ,,
Water	43·773	- 12·9 ,,
Total	100·000	

Which may be considered equivalent to $f\,S. + Al.\,S. + 13$ Aq. with a great excess of acid. The salt had a strongly acid taste. If we take the mean of this formula with those which precede, we obtain nearly.

$$2\,f\,S. + Al.\,S. + 20\ Aq.$$

which is quite different from the result of Phillips.

Of the three analyses contained in the table, the third, perhaps, approaches most nearly the mean composition of this substance, as it corresponds with the first so far as regards the acid and iron, and the water is identical with the result obtained by direct experiment.

From these facts, then, it appears that the hair salt of the coal strata varies in its composition. But this deduction is what we should have been inclined to draw, from the consideration of various analyses by different chemists, of specimens of similar salts from other localities, which affect the same form of crystallization, although consisting of totally different constituents. Thus sulphate of magnesia, sulphate of manganese, as well as sulphate of alumina and iron are found, we have also seen in capillary crystals.

* Poggendorff, Ann. xxxi. 142 † Ibid.

‡ Annals of Philosophy, Second Series, v. 446.

Upon what circumstances this remarkable asbestus form of soluble salt depends, it is not easy to determine, because they are indifferently met with in various species of rocks. This form, however, in insoluble minerals, as has been observed, is connected with serpentine rocks.*—*Records of General Science.*

THE INDIA REVIEW.

Calcutta : August 1, 1836.

PROSPECTS FOR THE PEOPLE OF INDIA.

The success of our new periodical is in some measure shewn by our having upon our list about 200 Subscribers, a commencement which encourages us to hope that we shall soon be enabled to diffuse in this country valuable and interesting scientific intelligence from all parts of Europe.

Recently six Scientific Journals were published in Great Britain: these have been reduced to two; one of which is published monthly in London, the other quarterly in Edinburgh. Since 1835, an additional work has been published, viz., "Records of Science." How long this last ably-conducted Journal will exist, it is impossible to say; but it is obvious there must be some cause for this want of success in works of Science. We ourselves believe the cause to have arisen from the articles having generally been too abstruse and subtle. It is true they were full of refined and speculative knowledge and recondite reasoning: replete with physical and metaphysical subjects. But then they were more adapted to the deep thinking philosopher than to the general scientific reader: hence a want of subscribers. The failure in Britain of periodicals which have been devoted solely to the diffusion of general science is a warning to us to consider well the grounds on which we anticipate success in our new undertaking. In a country like India where the British Sojourners and their descendants are comparatively few, the means of education as regard Science is but in its infancy; and therefore the importance of periodicals purely on the mere abstract branches of science is not felt. It is principally on this account that we have determined to blend with purely scientific matter, articles on the mechanical arts, and such other interesting subjects as regard improvement in manufactures, commerce, agriculture, &c., in order to suit the taste and promote the benefit of all classes. While we shall be able to admit subjects which embrace abstruse investigation into the causes of physical changes and determine the nature of bodies, reducing them to their elements, ascertaining their mutual actions and relation, we shall be able to apply the knowledge thus ascertained by demonstrative science to the improvement of arts which supply the wants as well as the comforts of life.

The grave philosopher and the man of science may not delight in articles of this latter description; but if he has attended to our explanations, he will no doubt find that our object is to secure extensive circulation, which will tend greatly to support that portion of our work which is to be devoted to those articles which he desires to see. Our great object is to be the means of leading to important local and national improvements of promoting traffic by Rivers, Roads, and Canals, by Steam Communication and Rail Road transit; in which to excite individual enterprize for large interest on capital, and to shew that such improvements call imperatively for the immediate attention of government for liberal appropriations. That stupendous machine, the steam engine has already undergone in its progress more than two hundred different modifications. It is our intention to give every new improvement in their motive forces from water, ether, alcohol essential oils, the liquifiable gases, atmospheric air, &c. The preparation of that invaluable and important metal, the chief material of nearly all machinery—Iron, shall receive particular attention as well as the various manipulations and mechanism employed in the great staple commodities cot-

* Thomson's Inorganic Chemistry, i. 161.

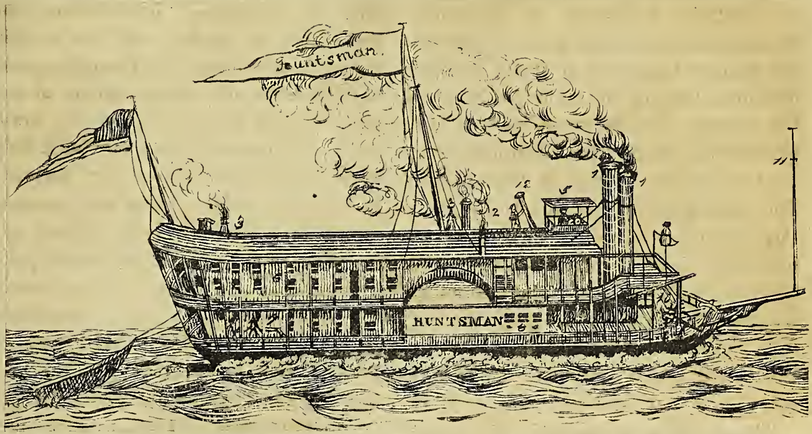
ton, silk, woollen, and linen. The construction of engines, mills, railways, carriages, ships, boats, docks, canals, bridges, furnaces, boilers, gas machinery, looms, presses, pumps, paddles, ploughs, water works, &c. will be illustrated by lithographic sketches, and an account given of the various important processes of dyeing, distilling, bleaching, brewing and tanning. While to the chemist and mechanic, we hope to be of essential service. We shall also do our utmost to meet the wishes of the naturalist. The extravagant price of standard works in this department has been to discourage the naturalist in his interesting study. We trust we shall be able to glean from the numerous works which are publishing, and from papers in the transactions of learned societies all that is novel and valuable for this class of our readers.

The question remaining to be considered next is, what benefit will such intelligence afford to a country like this, containing 1,116,000 square miles equal in size to Great Britain, France, Spain, Portugal, Italy, Germany, Hungary, Poland, and Turkey, put together; the number of people who inhabit it being computed at 100,000,000 souls. When the riches of other countries have been ascertained and made known through the chemist and geologist, may we not reasonably expect that they will excite a spirit of enquiry and a desire for scientific education in the people here; and that they will soon learn that this is the largest empire in the world;—the repository of the most valuable and precious ores; —the greatest repository of diamonds hitherto discovered; a country rich in spices, drugs, colours, silk, cotton, saltpetre, saffron, coffee, sugar, rice, &c.; that its manufactures in silks, embroidery, and cottons have long since excited the admiration of Europe; that its animal and vegetable productions, its metals, minerals, and valuable natural productions are scarcely yet known; and that science and the arts have yet to develope these internal resources which will ere long raise its character. Is it extravagant to hope under British rule that it will become the greatest commercial nation in the world. The realization of these objects, however, depends materially upon the policy which the government of India may adopt in regard to its revenue. Whether it endangers manufactures and population, or whether with the constant extension of boundary, it takes such measures to improve the soil, realize millions of acres which are now covered with forest, brushwood, and stagnant waters, whether it facilitates inland navigation, by deepening harbours, constructing docks, and encouraging ship building, the whole depends upon the adoption of a system of national polity by which the advantages to the government and the community may be reciprocal. It is during the times of peace that the great work of national improvement should go on, not as a matter of expediency, but of possitive necessity. If we desire to erect the fabric of our rule and future prosperity on a permanent basis, while we are giving encouragement to trace out the unexplored gifts of nature and bring into action the hidden treasures of the land, we must conciliate public regard by promoting the prosperity of the people. A specific sum might justly be appropriated to objects of national improvement, which, besides giving encouragement to ingenuity and merit and employment to the industrious, would promote the circulation of the specie throughout the country; increase the demand for various articles of inland manufacture and finally produce in their operation, an annual equivalent equal to the whole amount of the original outlay; and most probably exceed it.

We commence our department on Mechanical arts for this month, with suggestions, on the navigation of the Atlantic by steam, our esteemed contemporary the Friend of India, has called the attention of his readers to the mode of building steam vessels for the river. Is his plan applicable to the build of the Huntsman on a smaller scale? We however, trust, the subject, will lead to further enquiries and supply the desideratum pointed out by the able Editor.

PROGRESS OF SCIENCE

AS APPLICABLE TO THE ARTS AND MANUFACTURES; TO COMMERCE AND TO AGRICULTURE.



SUGGESTIONS ON THE NAVIGATION OF THE ATLANTIC BY STEAM.

Before I enter upon the details of the system, which is essentially different from any in use, I shall state what I consider desiderata to this end, all of which I hope are obtained in the proposed plan, though I do not pretend to insinuate that I consider my plans so good that they may not be improved; on the contrary, I think them extremely imperfect, and, consequently, quite open to improvement.

1. The vessels to be used in this species of navigation to be made as light as possible, and to combine safety with sufficient room, and the least possible resistance to the water below load-line, and to the air or wind above that line.

2. That these vessels shall be calculated principally for carrying passengers, and to carry but little baggage, and no ballast.

3. That they be constructed of iron, not only on account of its great levity, but for the increased safety resulting from its non-combustibility.

4. That these vessels be so rigged, that all the masts and rigging can with ease and facility be taken in, so that the least wind draft will exist when the wind is adverse; and that when the wind is favourable, the greatest spread of sail can be made with ease and rapidity, and with perfect safety, though the vessel is without ballast, properly so called.

5. That material and weight be economised as much as possible in the composition of boilers, engine, ship's furniture and stores, boats, &c.; and that the necessity of taking any supply of water for the voyage be entirely dispensed with, by the use of a species of fuel, hereafter to be described, which will constantly by its combustion produce an abundant supply of pure, wholesome water, thereby avoiding the dead loss of so much freight, which in ships intended for a long voyage is very considerable.

6. That one paddle be used instead of two, which must be placed so that it may be in or near the centre of the motion of the whole mass, and thereby always nearer a grip of the water, though the vessel herself may roll and pitch considerably. The position, and arrangement, and construction of the paddle to be such, that it cannot be too deeply immersed in the water, so as to do little or no good, which is so often the case in our steamers in rough seas.

7. The paddle to be so constructed that it can be entirely withdrawn from the water, so that it will not be in the way, when the sails without the steam can be used: a practice which would be economical, and give the engineers time to clean and repair the machinery, &c.

These are the principal requisites necessary to be obtained; some minor peculiarities shall be glanced at hereafter, which

being of a trifling character, need not here be insisted on.

In sketching or describing the machine by which I propose to navigate the Atlantic by steam, many seamen would not feel disposed to call it a ship I shall merely premise that every part and parcel of it has already been proved by practice to be effective in attaining the end proposed, and that I merely put together different parts of machinery which every body knows, or may know, to be actually in use. I shall not attempt to state which is the very best shape for the different parts, or their best possible proportions. My outline is general; it is not a working plan, which will require more heads than one to bring to perfection.

For the sake of preventing repetition, and not occupying too much of your valuable space, I shall state in order the different means by which I propose to attain the ends to be desired, which are as above stated.

1. Material to insure greatest lightness with greatest safety. Iron for the sheathing of bottom, and also cover over the deck, which might be considered as an extension of the hull's sheathing, and would resemble the back of an immense turtle. The deck proper below this, and on to which the small cabins would open, to be covered with wooden planks, or if made of iron to be covered with cement.

a. Such parts of the iron sheathing as would be below the occasional wash of salt water to be well cemented. The iron below water-line to be coated with copper, which should be left to the dissolving power of the sea, and, consequently, kept free from contract with any part of the iron, which should in all places be well cemented.

b. The ribs and timbers of the vessel to be made of iron and wood, according to their nature and position; but in framing the vessel the greatest strength and elasticity of the parts to be attained.

c. The vessel should be double, like the double steamers at the ferry in New York, or double proas of the Ladrone Islands. The last is the model after which I propose that part of the vessel under water should be built. They would, consequently, carry their *greatest breadth under water*, and slope from that upwards, gently rounding, so that at a distance, when the wind was adverse, an elongated dome, like the back of a whale or tortoise, would be alone seen above the surface of the sea.

d. Such a shape as this described would oppose but little resistance to the wind and least to the water.

e. And make accommodation for a very large paddle-wheel in the centre between the boats.

f. The crew and engine to be completely confined to one of the twin-boats; the other to be reserved for the exclusive use of the passengers; who might be allowed the recreation of a walk in fine weather on the ridge of the roof, the sides of which might be furnished with a temporary railing and netting. The roof to be furnished with ports or openings, bull's-eyes, &c., to admit light and air, and properly secured windows. These openings to be all closed on the weather side, when necessary.

g. The boats to be without keels' the flat sides of the opening between them, and in which the paddle works, being quite sufficient; or if not, lee-boards to be used when necessary, like those used by the Dutch galliots.

h. The bows of the vessels to be full, but not bluff, and to rise *quite perpendicular* above the water as high as the " bead" of the sea, or boil, as we landsmen call it, and that the bend of the roof should there begin. A sharpness in the bows, both above and under water, is necessary, but all *hollowing* of the parts should be avoided.

i. The two vessels to be firmly framed together, but no cross-timbers of the frame to be under the water-level. The transverse arch of the roof affords ample means for securing the two vessels perfectly safe in this respect. The arch of the roof, extending from stem to stern on the sides of the middle space, also offers every opportunity to the carpenter for framing, as it were, a double back-bone, or frame, on the flat side of each boat, which shall not only hold the paddle firmly in its place, but also the working cylinders of the engine, and effectually secure the machine from injury in " pitching," which otherwise might endanger the whole of the fabric.

k. The space between the boats to be as great as safety will permit, and the depth the least to which the hulls of each would sink. The first for the double purpose of affording the greatest breadth to the paddle, any also of giving greatest stability to the vessel when carrying sail, either before the wind, or on a wind, if the fire should fail, or any accident happen to the engine.

l. Vessels so constructed require two rudders, one of which is attached to each half, and both connected by a very simple contrivance, which makes them both act with equal effect.

m. The general proportions and bulk of a vessel of this construction will depend on

the business expected to be carried on with her, and also on the capital people may feel disposed to risk in the speculation.

n. The roof to have an opening in it, through which masts could be elevated, and rigged schooner or lugger fashion. The butts of the masts to be each fixed in a moveable centre, firmly secured in the middle frame. Such would be the breadth of the deck, that the sheets would be quite sufficient to spread the sails ; no " booms" would be necessary. Bowsprits could be easily run out ; and the rest of the rigging, such as stays, run down through the roof, through proper openings, and all got to rights in little time. The lower leech of the sail, when hauled flat, would rest upon the roof, which would thus become a part and parcel of the sail.

Your nautical readers will readily understand these suggestions. In my next I will continue the subject, with your permission.

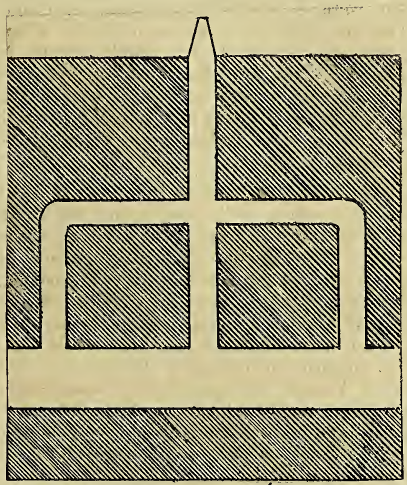
I send you here with the drawing of the Huntsman steamer, which was by some neglect omitted in my former packet. 1 1 are the chimneys ; 2, steam eduction-pipe ; 3 3, cabin chimneys ; 4, cooking-stove chimney ; 5, steering-station ; 6, ladies' cabin ; 7, gentleman's cabin ; 8, cook's house ; 9, boilers ; 10, fire-wood ; 11, flag-staff used for steering by ; 12, pipe from safety-valve.

Your well-wisher,

E. Talebois.

Liverpool, Oct. 7, *Mech. Mag.* 1835.

VENTILATION OF TUNNELS.



Sir,—I think the following plan for ventilating tunnels would be an improvement upon that which I have seen generally recommended. If the tunnel is one-fourth of a mile long, let a circular orifice be made, 12 inches in diameter, from the centre of the top to the surface ; snd if half a mile or more long, connect 2 other similar orifices in the manner represented in the following diagram, about 200 yards on each side of the centre passage.

These auxiliary orifices rising about five or six feet before passing to the principal, at not more than one-third of the width from the sides. Under each passage there should be placed a strong gas-light lamp ; so that all three lamps would be seen at either end. The main passage should, at two feet from the surface, pass through a fire in a close iron stove, with a continuation or funnel of three or four feet, contracted at the top to about four inches diameter. In this way an excellent ventilation would be produced at all seasons, from the strong current always rushing up to the rarified part.

I am, Sir,

Your obedient servant,

G. L. Smart.

Enfield, Dec. 4, 1835.—*Ibid.*

REPORT FROM THE SELECT COMMITTEE OF THE HOUSE OF COMMONS ON ACCIDENTS IN MINES: —SIR H. DAVY'S AND OTHER SAFETY-LAMPS.

The report from the Select Committee appointed by the House of Commons on the 2nd of June last. to investigate the subject of accidents in mines, which, together with the evidence given before the committee, was ordered to be printed on the 4th of the ensuing September, has lately appeared, and persents a body of facts and inductions from them of the most interesting and momentous character. We purpose to extract and transfer to the pages of the Repertory whatever relates to the subject of Safety-lamps, and afterwards to enter into a critical examination of all the evidence respecting it, and of the conclusions of the committee regarding it ; that portion of the entire subject which received the committee's attention being as important in a scientific as it is in an economical point of view ; and the means having at length been furnished, we conceive, of arriving at some satisfactory determination relative not only to the invention and progressive improvement of the safety-lamp, but also to the degree of actual safety to be obtained from its use, and the influence of its employment in the extension and conduct of mining for coal. We begin with the committee's report, retaining the marginal references to the illustrative points of evidence, many of which also we shall give in the sequel.

REPORT.

The Select Committee appointed to inquire into the nature, cause and extent of those lamentable catastrophes which have occurred in the mines of Great Britain, with the view of ascertaining and suggesting the means of preventing the recurrence of similar fatal accidents, and who were empowered to report the minutes of the evidence taken before them to the house;—have inquired into the matter referred to them, and have agreed upon the following report.—

Your committee have called before them witnesses connected with all the great mining districts of the kingdom. They have also examined plans, diagrams, and a great variety of lamps.

To the evidence which accompanies this report, your committee solicit the attention of the house.

Your committee have had ample opportunity of multiplying proofs of the calamities which have occurred in the mines of this kingdom*, by sudden explosions of fire-damp, foul-air, or sulphur, all which terms are locally applied to carburetted hydrogen gas, so copiously evolved in many of those mines.† Few collieries are entirely free from fire-damp, but in many the quantity emitted is so large, that, in spite of skill and unremitting attention, the risk is constant and imminent.

Having alluded to the *nature and cause* of the accidents which have taken place, your committee proceed to report upon the extent of the mischief which has resulted to property and human life.

The amount of damage sustained by these explosions‡ is described by several witnesses to have been great, and, when estimated in connexion with losses arising from interrupted trade, enormous; it is nevertheless rather with reference to the cause and interests of humanity than in a pecuniary point of view that this inquiry has assumed its just importance.

Your committee have failed in obtaining accurate information as to the number of lives lost within a limited period. Many documents, however, have been produced, from which much correct information on this portion of their inquiry has been derived.

In the course of the last session certain returns were made by the clerks of the peace of inquests held by the coroners on parties who had met with untimely deaths in the mines of England and Wales. These returns were very defective: from some counties the required information could not be obtained; in others, the nature of the accidents reported was not mentioned. They gave a total of 954 persons who had perished during the last twenty-five years. The following is a summary:—

	Lives lost.	
Chester......	7	fire-damp and choke-damp.
Cumberland	140	ditto ditto
Derby......	19	fire-damp and choke-damp.
Gloucester..	3	ditto ditto
Monmouth..	3	ditto ditto
Nottingham..	18	ditto ditto
Salop........	89	ditto ditto
Somerset..........	1	ditto ditto
Stafford, one district	104	ditto ditto
Warwick....	3	ditto ditto
York North Riding	29	ditto ditto
York, West Riding	23	choke-damp.
Ditto........	93	fire-damp,
Ditto........	230	other accidents not [specified.
Brecon..........	15	ditto ditto
Ditto............	3	explosions.
Flint............	39	choke-damp and fire-damp.
Lancashire (no returns for several districts).	135	ditto ditto
	954	

Many of the counties and divisions of counties from which no returns have been received are those wherein your committee believe catastrophes have occured, which would have materially swelled the catalogue. The counties of Durham and Northumberland, it will be observed, are omitted. As respect these, the most important of all, the exertions of an able and indefatigable collector have supplied the deficiency. Mr. John Sykes, of Newcastle, in his published "Local Records" of those counties, presented the public with a list of accidents from an early period.* The general correctness of that list has been proved; it was revised and amended by Mr. Puddle†, who affixed an asterisk opposite the names of the collieries which came under his personal notice at the times named. Those melancholy details are confined to what has happened on the banks of the rivers Tyne and Wear since the year 1710. It appears that in those districts alone,

There perished	1,479	by explosions of fire-damp
	14	by inundations
	37	by other casualties
	1,600	—Total since 1710

The list as drawn out furnishes an account, from 1810 of 1,125 lives lost; this, added to the general returns already alluded to, (defective and vastly short of the total, as your committee believe them to be,) striking fact requires to be particularly pointed out. If the year 1816 is assumed as the period when Sir Humphry Davy's lamp came into use, a term of eighteen years previous to the introduction of the lamp, 447 persons lost their lives in the counties of Durham and Northumberland*, whilst in the latter term of eighteen years the fatal accidents amounted

* 1514.2690.376. † 2030. ‡ 1524, 1666.773.

* Page 224. † 2377.2954.

to 538. To account for this increase, it may be sufficient to observe, that the quantity of coal raised in the said counties has greatly increased; seams of coal, so fiery as to have lain unwrought,* have been approached and worked by the aid of the safety-lamp.† Many dangerous mines were successfully carried on though in a most inflammable state, and without injury to the general health of the people employed in them.‡ Add to this the idea entertained, that on the introduction of that lamp the necessity for former precautions and vigilance in a great measure ceased.

This fact led your committee to a serious part of their inquiry, how are these calamities to be prevented for the future? They desire fully to recognize the undoubted rights of property, enterprise, and labour. They acknowledge their conviction, that the public interest has been served by the opening of the more dangerous mines§, and the competition their working has created, they do not overlook the anxious care alleged to have been maintained to diminish the attendant risk‖; but they deem it their duty to state their decided opinion, that the interests of humanity demand consideration, and they would gladly put it to the owners of the mines how far any object of pecuniary interest or personal gain, or even the assumed advantage of public competition, can justify the continued exposure of men and boys in situations where science and mechanical skill have failed in providing anything like adequate protection.¶

Immediately after their appointment, your committee received intelligence that a most awful and melancholy catastrophe had taken place at Wallsend colliery, between Newcastle-on-Tyne and Shields.** Having called for a copy of the evidence taken by the coroner, it has been produced, and accompanies this report. The particulars it contains, extracted in the course of an able and patient investigation, and the further elucidation of the case††, as contained in the evidence of Mr. Buddle before your committee, are of a deeply interesting character, the whole furnishing an example of a most dangerous mine, which, though conducted on principles sanctioned by some of the most eminent colliery viewers and best pitmen, cannot be considered secure from the recurrence of similar calamities. Your committee refer to the verdict of the jury, and to a document (pp. 177—78) containing the opinions of a highly respectable meeting in Newcastle, as proofs that, in the judgment of well informed individuals, no reasonable precaution had been omitted. The melancholy result was, that in an instant 101 men and boys were killed.

Here your committee would observe, that without any disposition to question the zealous and faithful discharge of their important duties by local coroners and juries*, it may be expedient to consider how far it is necessary to provide that, at the earliest possible opportunity, information of every accident attended with death to a large number of His Majesty's subjects, should be transmitted to the secretary of state for the home department, and that he, or the chief justice of England, His Majesty's coroner, should, at his or their discretion, direct the attendance of some fit and proper person or persons by them to be appointed, to be present at and assist the said coroner and the jury in their investigations. From such a proceeding results the most valuable to humanity and science might be obtained; the aim of justice would be still better secured, and to the public (particularly the relations of the deceased), the verdict would be delivered under the best possible recommendation, and with the highest sanction

The presence of carbonic acid gas†, or choke-damp, though less sudden and violent in its consequences, has proved a fatal attendant of the miner in innumerable instances, and this in districts where explosions are rare and insignificant.‡ Other noxious gases, varying in kind and combination, are also stated to exist in certain mines, and furnish additional subjects for chemical investigation.§ Inundations of water have occasionally been very destructive.‖ There still remains a long list of casualties¶, some of which are wholly beyond human control inseparable from mining pursuits, and their fatal results are often justly attributed to ignorance or a wanton neglect of ordinary caution, and a recklessness of danger in defiance of common discretion.**

Your committee, strongly impressed with the paramount importance of that part of the question referred to them which calls upon them to investigate the best method of preventing the recurrence of these calamities, have assiduously and anxiously inquired into the nature and success of the means already adopted. In this part of the inquiry your committee have had the voluntary and valuable aid of philanthrophic and scientific individuals to whom the community is greatly indebted. The means of prevention may be divided under three heads: 1. Ventilation: 2. Safety-lamps: 3. Maps or plans.

1. Ventilation††, by which is meant, any adequate supply of atmospherical air, sufficient as an active agent to displace deleterious gases, or so to adulterate those gases as to leave them no longer explosive, or, as in the case of carbonic acid gas no longer fatal to vitality.‡‡ On ventilation and the daily, unceasing, strict discharge of duty§§ by every person engaged about the mines, from the scientific, professional viewers, through all grades, the under viewer, the wasteman, the overman, the deputy, the lamp-keeper, the pitman, down to the trapper (often a boy too

* 1639. † 758.
‡ 1417.1491.363.1621.1859.1413 1623.1646.
§ 2396. ‖ 1794.1799. ¶ 2069.2090.2165.
** 1239. †† Pages 179.190.

* 2281 2264. † 1528.1849.2375.3345.684. ‡ 2506.
§ 876. ‖ 2366. ¶ 1824.2450. ** 1779.2040.2051. 2191.2252.2351 2965.1082.1132.
†† 1605. ‡‡ 527. §§ 1567.1613.

young and thoughtless who manages the air doors), depends the safety of hundreds of men and boys, from minute to minute; one act of omission of assigned duty, one solitary, momentary neglect, may cause the instant destruction of life and property to an indefinite extent.*

2. Safety-lamps; by the aid of which the miner is enabled to commence and continue his operation in situations where no naked light could be used, and at other times as a precaution against apprehended sudden changes in the atmosphere which surrounds him.†

3. Maps or plans, accurately defining not only the mode of conducting the air-courses, but the entire of the workings, pointing out also the position of adjacent abandoned mines, which may have become reservoirs of gas or of water.‡

The various modes of ventilating mines§ already in use, as well as those systems which have given place to improved methods, will be found detailed by various witnesses, and their merits so fully canvassed, as to require no comment from your committee. To enter upon a review of every plan and suggestion, would compel your committee to exceed the reasonable limits of a report. They do not hesitate to express a conviction, that whilst some mines equally foul, are naturally freed from large accumulations of gas‖, by the approximation of the seams of coals to the surface of the earth, others where the seams lie horizontally, or nearly so, require more shafts, additional opportunities for the injection of pure air and the rejection of foul, than are ordinarily afforded. A less parsimonious system in this respect¶, in the original design of those mines, and in their subsequent working, would have rendered easy otherwise difficult ventilation, and saved many valuable lives. The absolute necessity of greater attention to this point thas been fully established.

The practice of placing wooden partitions or brattices** in the ventilating shafts is deservedly reprobated; the slightest explosion may remove them, thus the whole system of ventilation is destroyed, and no timely aid can be rendered to the temporarily surviving sufferers. Your committee have reason to believe that this opinion is generally adopted in the coal mining districts.†† To this point they attach an importance, inferior only to the provision of a sufficent number of up-cast and down-cast shafts.‡‡ They consider that the evidence justifies the suspicion that the foul and free air courses are frequently too near to each other,§§ the communications not adequately protected, and that the lengths of of air-coursing are excessive, giving opportunities for leakage, interruption, and coutamination.‖‖ The temporary nature of the stoppings, often boards imperfectly united, sometimes mere heaps of small coal, and their frequent derangement*, inevitably produce dangerous consequences.

Your committee have endeavoured to investigate, with strict impartiality, the merits of the different lamps which have been brought under their notice. In the course of the evidence many varieties will be found described. The invention claimed by Sir Humphry Davy, on principles demonstrated by that able philosopher, may be considered as having essentially served the mining interests of this kingdom, and through them contributed largely to the sources of national as well as individual wealth. Many invaluable seams of coal never could have been worked without the aid of such an instrument†; and its long use throughout an extensive district, with the comparatively limited number of accidents,‡ proves its claim to be considered, under ordinary circumstances, a safety lamp. The principles of its construction appear to have been practically known§ to the witnesses Clanny and Stevenson, previously to the period when Davy brought his powerful mind to bear upon the subject, and produced an instrument which will hand down his name to the latest ages.‖

The attention of your committee has been drawn by different witnesses¶ to contingencies in mining, under which the lamp of Sir H. Davy ceases to afford adequate protection. Of the possible existence and nature of those contingencies**, your committee have ascertained that the inventor was well aware††, and they regret that the cautions he gave to some of his immediate friends were not made more public. Accidents have occurred where his lamp was in general and careful use; no one survived to tell the tale how these occurrences took place; conjecture supplied the want of positive knowledge‡‡ most unsatisfactorily; but incidents are recorded which prove what must follow unreasonable testing of the security of that lamp; and your committee are constrained to believe, that ignorance and a false reliance upon its merits in cases attended with unwarrantable risk, have led to disastrous consequences. The proofs collected in support of this opinion may be considered so many warnings to the miners of England. The prejudices which exist in many districts against the employment of the Davy lamp§§ are not occasioned by doubts of its protective character: the complaints made are of too little light‖‖, and the difficulty, in comparison with the use of the common candle, in bringing that light to bear with precision on the work, particularly in the thickest seams which are found in Warwickshire, Staffordshire, and other counties¶¶. Notwithstanding these prejudices, your com-

* 1611.16161.620.1045.2068.2253.2965.586.2995. 1126.1128.1482.
† 1961. ‡ 1092.1363.1391.
§ 1562.1568.1988.1994.2095.2612.2853.2916.3018. 3153.869.983.
‖ 2324. ¶ 2152. ** 1606.1651.2124.2128.2307. 2341. †† 2133.
‡‡ 2048.2173.3‡47. §§ 2176.4079. ‖‖ 1587.1644. 2540.

* 1695.3389. † 1664. ‡ 2588.1334.
§ 2236.334.340.1545.1556.1561. ‖ 1551.
¶ 1886.2558.2586.818.3833.3960. ** 2226.2787. 2941.2942.3446.
†† 2562. ‡‡ 3247.641.
§§ 2547.2556.2702. ‖‖ 1956.2701.3189.
¶¶ 1633.1761.1778.2239.2568.2747.470.

mittee conceive that no employer of miners can be justified in allowing caprice, or inconvenience to certain individuals, to interfere with a due protection to the lives of his work-people. In some mines, now lighted by the ordinary means, the use of the lamp, ought, in the judgment of your committee, to be compelled by the owners.

Many improvements, calculated to lessen the number of dangerous contingencies already alluded to, have been suggested, all these may be considered as extensions of the principle; such are the lamps produced by Messrs. Upton and Roberts, Mr. Newman, Mr. Martin, Mr. Douglas, Mr. Wood, and Mr. Dillon.* The lamps of Dr. Clanny and Mr. Ayres are provided with additional mechanical contrivances, intended to exclude danger, which might overcome the safety principle; and at once warn the miner of the insecurity of his situation, by the extinction of his light. All these are described in the evidence, except Mr. W. Martin's; a drawing which accompanies will serve that object; and Mr. Ayres's, which is a suspended extinguisher, descending on the flame immediately the gas inside the gauze is ignited; this lamp cannot be opened or interfered with without producing such extinction. Your committee have not ascertained how far the extinction of the lighted wick would also be acompanied by the extinction of the burning gas surrounding it.

In the experiments made before your committee at the London University, it may possibly be remarked, that the tests applied were such in nature or mode of application, as the known actual condition of the mines† would point out as satisfactory. It must not be forgotten that the object of those experiments was to ascertain which, of all the lamps produced, was, when exposed to the severest trial, best entitled to the name of "Safety-lamp." In these experiments the explosion of the gases within the lamp was effected in every one, and similar explosions produced externally, save Messrs. Upton and Roberts's. Your committee are, therefore, decidedly convinced that its construction possesses paramount merit. Your committee cannot admit that these experiments had any tendency to detract from the character of Sir H. Davy, or to disparage the fair value placed by himself upon his invention. The improvements are probably those which longer life and additional facts would have induced him to contemplate as desirable, and of which, had he not been the inventor, he might have become the patron. With the sole exception of unexpected destruction of the instrument, Messrs. Upton and Roberts's lamp appear's to your committee to provide against all, or nearly all, the contingencies attending the Davy-lamp. Mr. Buddle states, that tin shields‡, and a partial concealment of the lamp under their dress, constitute the prudential precautions taken by the miners in dangerous situations to prevent the flame passing the gauze when the lamp is agitated. The glass chamber does all this with greater certainty; its sudden fracture leaves the instrument a perfect lamp on Sir H. Davy's construction.* The introduction of the glass is not new; the novelties are, the shape of the glass, the collar which regulates the admission of air or gas to the cotton wick, and the double tissue of gauze beneath the wick, which prevents firing backwards.† If no practical objections are discovered‡, and your committee do not contemplate any which may not be readily overcome, Messrs. Upton and Roberts's lamp will supply a grand desideratum, especially if extensive experience should prove that the lamp and area of the gauze may be so increased as to allow of more light with safety.

On the necessity of having correct maps and plans, your committee have already reported. The long catalogue of casualties to which the miner is subject will be found detailed in the evidence. Mr. Roberts, one of the witnesses, produced to your committee his safety-hood, to enable persons to enter drains, wells, and mines charged with carbonic acid gas. Your committee report with pleasure their opinion of its great value, and of the merit of the inventor. The advantages to be obtained by having the safety-hood always ready for use are by no means hypothetical§, interesting proofs of what may be effected by its use have been received, and the practicability of saving life after explosions, when no hope remained, has been demonstrated.||

On a review of their labours, your committee cannot but feel apprehensive that they have in great measure failed in devising adequate remedies for the painful calamities they have to investigate; they entertain, notwithstanding, a sanguine expectation that the attention of the public will be availingly turned to this interesting subject.¶ The aid they have received from many scientific and philanthropic characters in the course of this inquiry, and the disinterested zeal the parties have manifested, warrant these hopes. How far legislative enactments** might come fairly in aid of the miner, has had the serious consideration of your committee. The great dissimilarity of the mineral stratifications of the kingdom, the constantly varying circumstance of particular mines††, render it in their opinion impossible, at present, to lay down any precise directions, or to form any rules of universal application‡‡. Your committee agree with many intelligent witnesses, that great benefit might be fairly and sanguinely anticipated from men of known ability being encouraged to visit the mines, whether in the character of distinguished chemists, mechanists, or philanthropists. Your committee are assured that these visits would be received with pleasure by the mine owners, and that every assistance§§ in the way of experimenting would be promptly afforded. They retain a grateful recollection of the results which followed the visits of Sir Humphry Davy.

On considering what may be due to the comfort and welfare of a class of men, who,

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* 364 371.815.821.1332.
†4061. ‡ 2229.3481.739.

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* 1903.3319 897.1048. † 1923.1946.3096. ‡ 1941. 3963. § 1853.3521.3545. || 2935. ¶ 766 775.
** 1813.4131.4166. †† 1806.1814. ‡‡ 4174.
§§ 2415,2509.

at great personal risk, contribute largely to the necessities, luxuries, wealth, of this great empire; the immense value of these mines to the community; the loss of life which has occcurred and the benefits which have already accrued from the labours and investigations of scientific characters; your committee have been disposed maturely to weigh the suggestions which have been made to them upon the necessity of having this inquiry continued in the mining districts*, by competent individuals, acting under authority. They are not insensible to the advantages which might result from such a proceeding; but many serious objections having been stated to the proposition, your committee conclude, under present circumstances, to abstain from giving an opinion upon the necessity or expediency of such a course.

Your committee are glad to find that increasing attention is paid to the moral culture and education of the mining population†. From the establishment of associations similar to the polytechnic school‡ recently formed in Cornwall, as named by one or more witnesses§, and the opportunity thus afforded of cultivating native talent‖, great advantages may be anticipated.¶ Whilst your committee have in the case just alluded to; had pleasing proof of the solicitude with which the welfare and safety of the miners are consulted in many places, they cannot express the sense they entertain of the responsibility incurred by the owners of mines generally**; in their hands are the lives of a vast multitude of their fellow-creatures industriously contributing to their personal and our national aggrandizement. The dependence placed upon agents and managers is necessarily great††, and doubtless, in many instances, from the characters of the individuals, justifiable. The number of subordinate overseers, under whatever name, ought never to be reduced on any pretence of economy; a vigilant oversight of these on the part of the owners, viewers or managers, as well as a determination to employ none in responsible stations who have not recommended themselves by long experience, skill, sobriety, and habits of strict attention‡‡, may prevent many accidents. It is the bounden duty of these owners carefully and constantly to examine into the state of their mines; if this is not personally practicable, they ought to call for written daily reports from their subalterns, of every circumstance and event connected with the proper ventilation of the mines. There will, however, still remain to be exercised that quick perception of cause and effect§§, that accurate adaptation of means to the end, that nice observation of various natural phenomena connected with the state of the atmosphere at the surface and under ground, upon which, it is obvious, safety must ultimately depend. Every possible exertion should be made‖‖, every effort employed to bring the workmen acquainted with their individual responsibilities, and those theories and principles, both as regards the lamps and proper ventilation, upon the observance of which their personal existence and that of their comrades are at stake.

In conclusion, your committee regret that the results of this inquiry have not enabled them to lay before the house any particular plan, by which the accidents in question may be avoided with certainty, and in consequence no decisive recommendations are offered. They anticipate great advantages to the public and to humanity, from the circulation of the mass of valuable evidence they have collected.* They feel assured that science will avail itself of the information, if not for the first time obtained, yet now prominently exhibited; and that the parties for whose more immediate advantage the British parliament undertook the inquiry, will not hestitate to place a generous construction on the motives and intentions of the legislature.

September 4, 1835.

The report concludes with a list of thirty-six persons from whom communications have been received by the committee, and which, it is stated, "have received due attention."

OBSERVATIONS ON INSECTS PRODUCING SILK, AND ON THE POSSIBILITY OF REARING SILK CROPS IN ENGLAND BY THE Rev. F. W. HOPE, F.R.S., &c.—Previously to entering on the subject of this paper, I will offer some statistical *details*, illustrative of the vast importance to the commerical prosperity of this great country, of the few insects producing silk. These details may stimulate the entomologist to pursue particular lines of inquiry; and may we not hope that the result of such researches will be the addition to our productive sources of various new species of these little labourers, to whom man owes so much?—species which might be available at our own doors, by the capacity of enduring our climate, and thriving on its vegetable productions, and, in case it were necessary, by having recourse to artificial means for their culture? May we not suppose the manufacturer would find his hot-houses for silkworms as profitable a speculation, with extended demand, as the fruiterer does his hothouse for the supply of the comparatively limited demand for the luxurious desserts of the rich?

In the years 1822-3 respectively, the quantity of silk imported for home consumption was 4,392,073 lbs. and 4,758,453 lbs., being an increase of $3\frac{1}{2}$ per cent. in the latter year. The value of the exports for those years was 529,990*l*., and 740,294*l*., being increase of 40 per cent in one year. The average for ten years, from 1814 to 1823, and the succeeding ten years, exhibits a more striking and gratifying difference; the first period giving for annual home consumption 1,580,616 lbs., and the last ten years, 3,651,810 lbs., being an increase of 131 per cent.

*‖2509.
† 222. ‡ 205. § 3174.1193. ‖ 1870. ¶ 3945.
** 1761. 2163.2458.3690.533. †† 615.737.2230. 4431.1353.
‡‡ 1803.2063.2960. §§ 3737.1809 1669.1676. ‖‖ 1703.2804.3167.3792.783.

* 1872.1381.1384.776.

On the authority of Mr. Winkworth, I state the number of persons employed in England in the silk trade in 1823 at 500,000; and at the present moment there are probably 700,000 engaged in it. Leaving these details for the present, let us now proceed to the examination of insects producing silk.

The chief insects which produce silk are ichneumons, spiders, and moths. My friend, Mr. Stephens, will this evening exhibit to your notice a specimen of ichneumon-silk; and as it is more likely to prove an object of curiosity than utility, I pass on to spider-silks.

Several genera of spiders produce silk of various strength and qualities, such as the gossamers, and our domestic species, as well as many others. In France, Monsieur Bon had gloves and stockings manufactured of it: sufficient experiments, however, have not yet been made to ascertain the quantity and qualities of spider-silk.

If in Rome the whimsically extravagant emperor, Heliogabalus, collected 10,000 lbs. weight of spiders, as a vain display of power surely in this metropolis we might collect a sufficient quantity of cobweb to perfect any experiments on a silk likely to be as strong as that obtained from *Bombyx Mori*, and probably less impervious to wet; a silk, however, not likely ever to be much in vogue, from the natural antipathy which prevails against spiders from the difficulty and expense in collecting the web, and the impracticability in breeding spiders in any numbers, arising from their voracious and predatory habits: but the cocoons might be gathered and unwound. Abandoning our indigenous webs, such as float over the fields, as well as those which hang in dusky wreaths in garrets and in cellars, we may naturally expect to meet with exotic and tropical species which yield silk worth attention. It is probable that the cylindrical sacks of the gigantic *Mygale* may be advantageously collected, as the cocoons equal in size large walnuts, in one nidus of which 100 young ones have been discovered: it is reported, also, that some kinds of web are so strong that birds are entangled in the meshes, and that their webs oppose a certain degree of resistance even to man himself. In concluding my remarks on spider-silk, I would recommend that attention be directed to the silk obtained from *Epeira clavipes*, a spider abundant in Bermuda: fine specimens of its silken cocoon may be seen at the British Museum; and other species of the same genus also are deserving of attention.

MOTH SILK.

The principal moths producing silk belong to the genera *Clisiocampa*, *Bombyx*, and *Tinea*. The *Bombyx Mori* (the proper type of the genus) yields it in great abundance: this species has become naturalized in the fairest portions of the globe.

As it appears from the statistical details that silk is so intimately connected with our commercial and manufacturing interest, it is evidently worth while, for the prosperity of those interests, to recommend its increased cultivation; and really, if ever there was a period when its cultivation could be carried on with increased success, it is the present moment. Look at our Indian possessions in the full enjoyment of peace: the English, ruling these extensive territories, might induce the natives to grow (if I may use the term) any quantity of silk, sufficient to glut all the markets of Europe. In these regions there are generally eight successive silk crops; some authorities assert even more. Extending, moreover, our views to China, as the trade with that country is now thrown open to British capital, enterprise, and industry, we may naturally expect that a stimulus may be applied there to its increased production. Abandoning for the present, however, foreign produce, it remains to state the possibility of growing silk in England, and this part of my subject requires a thorough investigation. Prussia, Bavaria, and even Northern Russia, whose climates are not superior to our own, grow annually large quantities of silk; and why does not England do the same, the answer is, the price of labour is here too high; secondly, the experiments tried have already failed. Notwithstanding these assertions, I think that it is possible to grow silk in England, and grow it even with success and profit. To meet these objections I would suggest, first, that we ought to breed silk-worms in hot-houses throughout the year; and, secondly, that the Pavonia Moths of Europe and other countries, as well as the Atlas Moths of Asia, should be reared in like manner. It has already been remarked, that several corps are obtained in the East within the year; and why may we not also expect in England several, by means of breeding the worms in hot-houses. In India the longest period for a generation of silk-worms appear to be forty days: even allowing fifty days in England for a generation, we may then expect seven crops of silk. If we only obtained four, that is double the number produced in Italy, where they annually rear but two. I need now scarcely add that four crops will no doubt repay the speculator for rearing silk. To reduce, however, his expenditure as much as possible, I would recommend him to feed the silk-worms with lettuce instead of mulberry-leaves; first, as there is less expense in the cultivation; secondly as, the lettuce can be grown cheaply in cucumber-frames during the winter months; and, lastly, as the quality of the silk does not depend so much on the *quality* of the *leaf* as it does on the *degree* of temperature in which the worm is reared. I would strenuously recommend tbe lettuce. Should the food of the mulberry-tree, however, be preferred to the lettuce, we can still adopt the discovery of Ludovico Bellarde, of Turin. His plan consisted in giving the worms the pulverized leaves of the mulberry-trees, slightly moistened with water: the leaves were gatherin the previous summer, dried in the sun, reduced to powder, and then stowed away in jars for the winter food, or till the tree was in full foliage. Repeated experiments made by Bellarde prove that the worm preferred this kind of food to any other, as they dovour it with the greatest avidity. To reduce still further the expenditure, old men, women, and children might be employed in feeding the worms, as

is the case at present in India: indeed might not the poor in the workhouses be rendered available, thus affording them amusement and profit?

With regard to rearing other silk-moths, I am well convinced that the *Pavonia minor* might be propagated to any extent in this country, as the larva are general feeders, probably the Lacquey Moths might also be reared with success; the larger *Pavoniæ* of Europe, and other countries should also be tried. But a great object would be to import the eggs and breed the Atlas Moths in England, which have already yielded a fine silk well worthy the attention of the manufacturer of Great Britain.

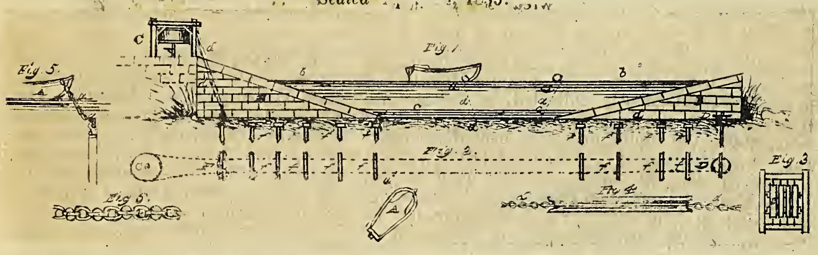
As there is not time at present to enter into the merits of the Tasseb, Arrindi, Bugby and Kilisurra silk-worms of India, I merely mention the chief writers on this subject, viz. the celebrated James Anderson, Dr. Roxburgh, General Hardwicke, and Colonel Sykes, the two last, I am happy to say, are members of this Society, and I am sure will most willingly give all assistance in their power towards the attainment of so desirable an object as that of rearing silk in this country.*

In concluding these remarks, I would suggest the formation of a committee to investigate all that relates to silk. Let the silk manufacturer learn that the committee is disposed to give him all the assistance in its power, that it is equally desirous of his advice and observation; let the mechanic learn that we need his practical aid on which he alone can give us useful assistance. A report, emanating from this society, embodying in it the opinions of the manufacturer and entomologist, would do some good. If the object of producing silk in England fail altogether, we shall still have the merit of meaning well: should it exceed, however, thousands of our poorer countrymen will find employment and reap the benefit.—*Transactions of the Entomological Society of London*, vol. i. 1835.

* Should the first attempts fail, eventually there is every reason to believe that success must follow perseverance as it has already done in other countries Till that wished for period arrives, I would earnestly recommend not only the increased cultivation of silk in India, but in all our colonies, most particularly in New Holland. At the Cape of Good Hope, at the Mauritius, at Malta, at the barren rocks of St Helena, the silk-worm has been introduced with partial success; and from those countries may we not in future calculate on some increasing produce?

SPECIFICATION OF THE PATENT GRANTED TO JAMES BOYDELL, JUN., OF DEE COTTAGE, NEAR HAWARDEN, NORTH WALES, FOR IMPROVEMENTS IN MACHINERY FOR TRACKING OR TOWING BOATS OR OTHER VESSELS.

Sealed [illegible] 1835.



To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said James Boydell, do declare the nature of my said invention to consist in the construction and arrangement of certain apparatus of machinery by which boats or other vessels may be tracked, towed, or moved, in a manner possesing particular advantages, under particular circumstances, as will be hereafter explained; and the manner in which the same is to be performed or carried into effect, will be more clearly seen by reference to the annexed drawing, and the following description thereof.

It will be remarked that certain letters and figures of reference are used in this descrption and drawing, but that the same letters, when repeated, indicate the same parts throughout.

DESCRIPTION OF THE DRAWING.

Fig. 1, represents a sectional view of a ferry or ford to which my improved apparatus or machinery is applied, and,

Fig. 2, a plan or bird's eye view of part of the same machinery or apparatus.

In these figures, A, represents a ferry boat floating on the surface of the water, and, *a*, *a*, the chain or cable, which I call the bridle, by which it is held and prevented from drifting by the current or stream. *b*, *b*, indicate the high water mark, and, *c*, *c*, the low water mark (see fig. 1); this ferry being subjected to the influence of the tide. B, B, represent two inclined planes or landing places of masonry, for the convenience of landing carriages or passengers at all times of the tide.

C, is a whimsey, which may be worked by horse or other power, around the drum of which is carried the endless chain, *d, d, d, d*; this chain is carried across the river or ferry, and on the opposite side to that on which the whimsey, C, is placed, where the chain is passed round an horizontal warve or pulley, D, from which it returns to the whimsey, C, in a parallel direction to that in which it was carried across the river, as best seen at fig. 2, where, as already stated, the same letters indicate the same parts as in fig. 1. Now by tracing the revolution of the drum or barrel of the whimsey, round which the chain, *d, d, d, d*, is wound, it will be clear that the motion imparted to the chain will cause one of the parallel lines of the chain at the bottom of the river or ford to move in one direction while the opposite line of chain is moving in the reverse direction, as indicated by the small arrows placed near the chain in the drawing, and also that the direction of motion of the chain must depend on the direction of rotation imparted to the whimsey. The bridle, *a, a*, which holds the ferry boat, A, from drifting down the stream, is attached or fastened to one of the parallel sides of the chain, *d, d, d, d*, and it is by the motion of the chain, *d, d, d, d*, that the ferry boat, A, is tracked or towed from one side of the ferry to the other, and returned by the same means when the rotation of the whimsey, C, is reversed. To prevent the chain, *d, d. d, d*, bedding itself in the sand and to decrease the friction experienced in moving it across the bed of the river, I have placed friction pulleys to support it, as represented at *f*, and also four guide pulleys intersecting each other, as seen at F, and separate in a front view on a large scale at fig. 3, for the purpose of keeping the chain, *d, d, d, d*, at the bottom of the river or ford. But the necessity, or not, of these precautions must greatly depend on the extent of the ferry and nature of the bed of the river or ford, and must, in all cases be left to the judgment of the engineer or parties entrusted with the construction of the apparatus. From the foregoing description of the annexed drawings it will be seen that the ferry boat, A, being held by her bridle, *a, a*, and acted on by the stream, would partake of the property of what is generally called a flying bridge, and sheare or move by the action of the stream on the rudder when placed on the proper angle, even supposing the chain, *d, d, d, d*, to remain at rest; and this shearing motion of the boat, A, which is gained by the action of the stream on the rudder, as is well known to seamen and persons conversant with marine affairs, greatly assists the traverse of the boat across the ferry, and thereby greatly diminishes the amount of force required to move the whimsey, C. It will also be remarked that, in such situations as are affected by the tide, I have found it convenient to attach two bridles, one to each side of the moving chain, with a small buoy to the other, to which this boat, A, is attached, whenever the direction of the stream is reversed, thereby preventing any crossing of the chain, *d, d, d, d*, which would occur if this precaution was not adopted. The arrangement and construction of the parts shewn at figs. 1 and 2, are the most simple, except the placing of a single chain or hawser with a whimsey on each side of the river, and perfectly efficient where the bottom of the ford or river is hard and tolerably level, but, in some cases it may be required to place a guide for the chain at the bottom of the river, which I propose constructing of the form as seen at fig. 4, which represents a plan, and fig. 5, a transverse section of a tube provided with a longitudinal opening or slit. This tube must be confined on the bed of the river by piles or other means as circumstances may allow. In this position it will become a guide for the moving chain, *d, d, d, d*, one part of which is passed down the interior of the tube, and the position at which the boat is attached will be sufficiently obvious by the letters of reference. Although the above description refers to the moving or passing a boat across a ferry or ford, which I have already put in execution, it will be obvious that a similar arrangement of apparatus may be readily applied for the purpose to tracking or towing boats on canals, through tunnels, and into the flood-gates of docks and similar places; and in long distances, such as passing tunnels, where the weight of the moving chain on the bottom or bed of the navigation would cause too great an amount of friction, I adopt the following means of lessening it.

Fig. 6, represents a side view of part of a moving chain the links of which are provided and filled with wood or any other buoyant material, the proportion of which to the weight of the link of chain may be varied by increasing or diminishing the size of the link; I am thus enabled to render a chain either totally or partially buoyant, and to diminish the amount of friction in moving such chain, inasmuch as its buoyancy is increased. The advantages arising from this application of my invention to ferries, similar to that set forth and described at figs. 1 and 2, are, that the ferry boat is passed across much readier than by the ordinary method and at any time of the tide, without impeding the navigation of the river or canal, at the same time that the natural position which the boat assumes with her bows to the stream render the passage of the boat much safer in rough weather, as well as much easier moved under any circumstances. In tracking or towing vessels on canals or under long tunnels, where canals occasionally are carried, the partial buoyancy given to the chain, as described at fig. 6, will so decrease the friction of the chain, used for such purposes, as to render the tracking of vessels, in such circumstances, more advantageously and rapidly effected.

Having described the nature of the invention, and the manner in which the same may be performed and carried into effect. I hereby declare that I do not claim, as of my invention, any separate or well known part of the apparatus or machinery hereinbefore described. But I do claim as of my invention, the construction, arrangement, and adaptation of a

moving chain, rope, or hawser, placed beneath the surface of the water of a navigable river, lake, or canal for the purpose of tracking or towing boats or any other vessels as hereinbefore described at figs. 1, 2, 3, 4, and 5; and I also claim, as of my invention, that peculiar construction of chain, as set forth and described at fig. 6, for the purpose of tracking or towing boats and any other vessels; and these my improvements being to the best of my knowledge and belief new and never before used, I deliver this as my true and faithful specification of the same.—In witness whereof, &c.

Enrolled October 12, 1835.—*Repertory of Arts.*

EXPERIMENTS ON INDIGO.

By Nath Ogle, Esq.

I have lately been engaged in a set of experiments on the indigo; and as that substance is now so universally known as a permanent and beautiful blue dye, it may not be altogether uninteresting to your readers to give a sketch of its chemical characters, which are very striking and rather complicated.

Indigo of commerce is by no means a pure colouring principle. It contains a variety of foreign matter, part of which it may have derived from the plant from which it was extracted, and part may have been added to it through carelessness in its preparation; of 100 parts, a good specimen will not afford more than 50 of real blue.

It is a matter of considerable importance to devise some simple, and, at the same time economical plan of analysing this drug, not only for the purpose of ascertaining the exact quantity of colouring matter a given specimen contains, but also what is the nature of its impurities, which I have found to vary considerably in different sorts. In order to find the value of a sample with respect to its proportion of blue, Mr. Dalton proposes to dissolve one grain in sulphuric acid, transfer the solution into a tall cylindrical glass jar containing water, and then to destroy the colour by chloride of calcium, the value of the indigo being in proportion to the quantity of the chloride necessary to destroy its colour. I consider this to be, at best, a troublesome method, and not entirely to be depended upon. I made several experiments on two samples, one an excellent East India, and the other a very inferior Guatamala; but the quantities of chloride of calcium required to destroy the colours were so nearly the same, that the superiority of the East India was not manifested.

Chevreul gives us a very good method of analysing indigo in the rough manner. He directs that it be first digested with water, which will take up 12 or 14 per cent, but the quantities varies much in different samples. The water acquires sometimes a yellow, but usually, especially with Guatamala's a dark brown colour; this solution by exposure to the air precipitates flocks, having a green colour, which appear to be partly composed of indigo, becoming blue when left in the air; the greater part continues green; is soluble in alcohol and solution of potash, but does not ever turn blue. I have found that this green matter, which is very slowly thrown down by the action of the air, is immediately and plentifully precipitated by dropping muriatic acid into a concentrated liquor; and in the specimens on which my experiments were made, the precipitate from the Guatamala was much more abundant than that from the East India; the liquor from the former was much darker than that from the latter, and it was remarked that the Guatamala was very inferior as a dye to the East India, yet the quantity of real indigo in each did not appear to vary much. I conclude, therefore, that the difference in quality was owing to a more than usual quantity of gluten and brown matter, and that these substances are more injurious than is generally supposed, tending to destroy the peculiar brilliancy of the indigo.

After water has extracted all that is soluble in that menstruum, Chevreul directs that the residue be treated with alcohol in successive portions, by which a further quantity of green matter is taken up, but so mixed with another red substance that it assumes a dark, ruby colour. Chevreul states, that 30 grains out of 100 are taken up by alcohol, which is rather more than I found. Lastly, muriatic acid takes up a further portion of red matter, together with alumina, lime, and oxide of iron; and pure indigo, amounting to 45 or 50 per cent., remains, usually mixed with a small quantity of silex.

When indigo is exposed to a temperature about equivalent to that of melting lead, it rises in the form of a beautiful purple smoke. This was known long before any attempt was made to obtain it in a crystalline form by sublimation. If, however, a proper apparatus is employed, and precautions adopted, it may be thus produced, and then assumes a very beautiful appearance. The best indigo for the purpose is that precipitated by agitating in contact with air the yellow solution of deoxidised indigo, which forms the dyer's blue vat; but where that cannot readily be obtained, common indigo may be used. In the latter case, 30 or 40 grains in coarse powder must be placed in a shallow metallic saucer, and a spirit-lamp applied to the bottom till the surface becomes covered with a copper-coloured, mossy-looking substance, taking care to remove the source of heat the moment purple vapours appear. When the saucer is cool the crystal must be brushed off with a feather, and placed in another similar saucer furnished with a cover, so applied that the internal surfaces may not be more than half an inch apart. A second application of heat will cause the pure crystals to rise and plant themselves on the upper vessel, the impure substance remaining behind of a coaly appearance.

The crystals thus produced bear a very small proportion to the quantity of indigo employed. As an average of four experiments from 10 grains of impure indigo, obtained by sublimation half a grain of crystals, and the residue weighed 6½ grains, showing 3 grains of volatile matter to have escaped. The crystals volatised leave no residue. When they are

viewed through a microscope, they appear as long, flat, ocicular crystals, appearing red by reflected, and blue by transmitted light; they are not, however, always so, sometimes, particularly at the commencement of their formation, assuming the form of very thin plates, appearing almost opaque; indeed, when lying in a mass, they always have a brown colour.

Sublimed indigo may be analysed by heating it with peroxide of copper in green glass tubes. Mr. Crum gives its ultimate constituents thus:—

Carbon............	73·22
Azote	11·26
Oxygen	12·60
Hydrogen ····	2.92
	100.

These numbers correspond very nearly to,

1 atom of azote	1·75 or	10·77
2 atoms of oxygen	2·00 or	12·31
4 atoms of hydrogen	0·50 or	3·08
16 atoms of carbon	12·00 or	73·84
	16·25	100..

I am, however, disposed to consider the quantity of carbon to be greater, and the quantity of oxygen to be smaller. I have repeatedly analysed both sublimed and precipitated indigo over peroxide of copper and protochloride of mercury (calomel), and have obtained 84 as the mean proportion of carbon in 100 parts; and it was only when calomel was employed that I obtained satisfactory proof of the presence of hydrogen. But since Mr. Crum's analysis is generally considered pretty correct, I do not at present place much reliance on my own discordant results. Organic analysis is a very delicate operation, and requires much experience and a peculiar apparatus, neither of which have I the advantage of.

In the year 1827, Berzelius published an excellent memoir on indigo. He found in it four peculiar substances, which constitute its chief ingredients, viz. 1st, a substance closely resembling gluten; 2d a brown matter; 3d, a red matter (the resin of Bergman and Chevreul;) and 4th, the proper colouring principle.

From a sample of good East India indigo I extracted the gluten by first boiling it with diluted sulphuric acid, then filtering and neutralising the acid by carbonate of lime, after which it was evaporated to dryness and alcohol boiled on the residue; this extracted a substance resembling gluten, and particularly characterised by its smell, which was very similar to broth. Gluten is itself a substance possessing properties in common with both the animal and vegetable kingdoms, hence it has been called a *vegeto-animal* substance.

The brown matter I separated from the residue left by the acid by gently heating it with a weak solution of potash, and from the residue again alcohol extracted the red matter. The alcoholic solution being evaporated to dryness, left a ruby-coloured powder, which was dissolved by nitric acid, forming a fine port-wine coloured liquor, which colour it did not long retain, but soon, in consequence of decomposition, turned yellow.

After these operations have been performed on it the indigo is not left in a state of purity; it contains, besides insoluble impurities, a portion of the green, red, and brown matter; but by acting on it by the protosulphate of iron and lime, and pouring the yellow solution of deoxidised indigo, thereby obtained into diluted muriatic acid, a copious blue matter falls down, which, after washing, may be regarded as tolerably pure.

By acting on indigo by means of protosulphate of iron and lime, Liebeg produced a substance which he considered to be pure deoxidised indigo. The proportions I used in repeating his experiment were, 1,000 grains of the during, 1,500 of copperass, and 1,600 of lime; these were put into a stone jar, and 3 quarts of water poured on them; the whole was then heated to 130° Fahr., and so kept for 18 hours, guarded as much as possible from atmospheric air; the clear yellow solution was then drawn off by a syphon, previously filled with hydrogen gas and mixed with diluted muriatic acid, holding in solution a little sulphate of ammonia; a thick precipitate fell down, which was washed with water that had been boiled, and dried at the temperature of 212°; when quite dry it retained its white colour even when exposed to the air, but when moist it speedily became blue. To this substance Liebeg gave the name of indigogen, and he ascertained that in passing into the blue indigo it absorbs 11·5 per cent, of oxygen. The preparation of this substance, owing to its powerful affinity for oxygen, is extremly difficult, and it was only after repeated trials that I succeeded in producing it. It is absolutely necessary that all the vessels employed should be previously filled with either nitrogen or hydrogen, and the water employed be deprived of air by long boiling.

The action of some of the acids on indigo is extremely interesting. With the nitric acid, it forms two distinct substances, according to the strength of the acid and the manner in which it is applied. When a part of indigo is mixed with 8 or 9 parts of moderately strong nitric acid, and boiled as long as nitrous fumes are evolved, *carbazotic acid* is formed. When the indigo is added to diluted nitric acid kept boiling, as long as effervescence continues, hot water being occasionally added to supply the loss by evaporation, *indigotic acid* is formed.

The particulars of the preparation of each are as follows:

To form carbazotic acid, I boiled some small fragments of the best East India indigo in ten times their weight of nitric acid; the mass frothed and swelled, giving out a large quantity of nitrous gas, mixed with carbonic prussic acids. It is recommended by some chemists to add successive portions of nitric acid whilst boiling; but there is nothing, I believe, gained by this. I have tried repeatedly both plans. The solution is bright yellow, and contains, besides carbazotic acid, artificial tannin, resinous matter (which forms a film on the surface), and indigotic acid—on cooling, carbazotic acid is freely deposited, but not in a pure state, mixed probably with a considerable quantity of indi-

gotic acid; the residual liquor, by evaporation and adding cold water, yields an additional quantity.

The crystals were dissolved again in hot water, which was divided into two equal portions, one of which was neutralised by carbobonate of potash, and the other by carbonate of ammonia; carbazotates of potash and ammonia were formed, and repeatedly purified by crystallisation. The former salt appeared in the form of long, yellow, semi-transparent, and very brilliant needles; the latter formed yellow, flattened crystals. Carbazotate of potash possesses the property of detonating when heated like fulminating silver; carbazotate of ammonia is fused and volatilised without decomposition. It may be here observed, that the sparing solubility of carbazotate of potash renders its acid an excellent test for potash. Carbazotic acid is easily separated from the salts by the addition of sulphuric acid; its crystals are in the form of brilliant, yellow plates; it is extremely bitter, and said to be poisonous; it may be fused and volatilised without decomposition, but when exposed to a strong heat it explodes, leaving a residue of charcoal.

By Liebeg's analysis this acid contains no hydrogen, but, as its name implies, it is a compound of carbon, nitrogen, and oxygen, in the proportions of 15 carbon, 3 nitrogen. Others give different proportions, and Dumas found in it 1·4 per cent. of hydrogen. It may be formed by the action of nitric acid on many animal and vegetable substances, as silk, aloes, &c.

To form indigotic acid, indigo in coarse powder was mixed with nitric acid, diluted with an equal weight of water; carbonic acid and nitrous gas were produced, but no carbazotic acid; when effervescence had entirely ceased, it was allowed to cool; a thick, white precipitate fell down, which was boiled with oxide of lead, and filtered in order to separate the resin; the clear, yellow solution was decomposed by sulphuric acid, and filtered at a boiling temperature. Indigotic acid was deposited on cooling in minute, yellowish white needles; by repeatedly dissolving and re-crystallising it finally assumed the form of a tuft of feathers.

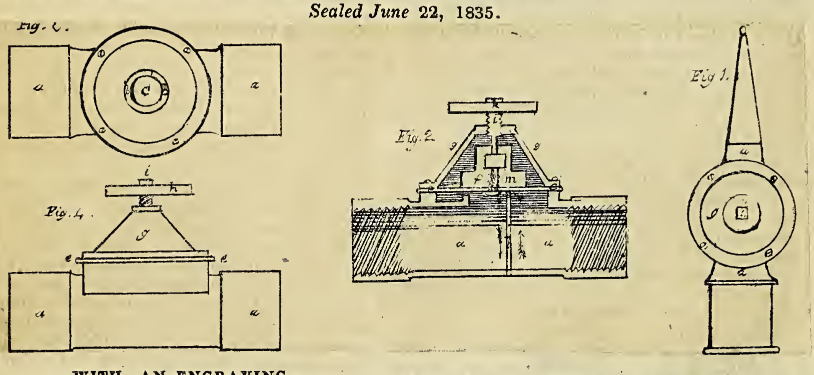
(To be continued.)

INDIAN INK.—An easy and expeditious method of providing a substitute for Indian ink, is to boil parchment slips, or cuttings, glove leather, in water, till they form a size which, when cold, becomes of the consistency of jelly; then having blackened an eartheny plate, by holding it over the flame of a candle, mix up with a camel-hair pencil the fine lamp-black thus obtained with some of the above size, while the plate is still warm. This black requires no grinding, and produces an ink of the very same colour, which works as freely with the pencil, and is as perfectly transparent as the best Indian ink. It likewise possesses the advantage of furnishing artists with a substitute for the article, which may be prepared where it may be difficult to obtain the ink itself.

DRAWING ON CLOTH.—A new method of drawing on cotton and linen cloth has lately been invented by Mr. John Buck, of 12, Parker-street, Westminster, which possesses, as far as regards the portability and durableness of the material, a great surperiority over every other yet devised. The cloth is first prepared by rubbing into it an adhesive composition, which unites the threads, and makes it as easy to draw upon as paper; and after the drawing has been made, it is done over with a "thin pellucid liquid," of varnish. It might be supposed that cloth thus treated would be stiff and liable to crack; but, on the contrary, it admits of being folded of in any shape or size, with the greatest ease, and without injury. A whole estate, or township, as the inventor observes, "may, by this means, be introduced into a pocket-book."

SPECIFICATION OF THE PATENT GRANTED TO ELIAS CARTER, OF THE CITY OF EXETER, GENTLEMAN, FOR AN IMPROVED APPARATUS FOR REGULATING THE SUPPLY OF GAS TO THE BURNERS, AND FOR STOPPING OFF THE SAME, APPLICABLE ALSO AS A COCK IN DRAWING OFF OR REGULATING THE FLOW OF OTHER FLUIDS.

Sealed June 22, 1835.



WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c—*Now know ye*, that in compliance with the said proviso, I, the said Elias Carter, do hereby declare the nature of my said invention and the manner in which the same is to be

performed are fully described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):

DESCRIPTION OF THE DRAWING.

Fig. 1, represents my improved apparatus affixed to a gas-burner.

Fig. 2, is a longitudinal section of one of the said apparatus shewn separately, and is intended to be screwed or otherwise fastened to any tube through which gas or other fluid is to be passed, and the flow of which is required to be regulated or stopped off.

Fig. 3, is a plan of fig. 1, and,

Fig. 4. is a side view of the same apparatus.

In each of these figures the same letters indicate similar part; *a*, *a*, being the tube or way for the flow of the gas. *b*, is a partition formed within the tube, *a*, thus dividing the tube into two chambers or parts. *c*, is an opening formed in the tube, *a*, the upper portion thereof is of a circular form, which is the shape I prefer, but do not confine myself thereto. This arrangement is clearly shown in fig. 3, the valve being removed in order to shew the construction. The valve by which the opening, *c*, is closed or contracted consists of a flexible material, *e*, fastened by a screw or other means to the part shewn in section at *m*, which covers completely the opening, *c*, and which for gas apparatus, and for purposes where the chemical properties will not injure the same, I use leather, which is screwed to the part, *m*, and the leather valve is affixed gas-tight over the recess formed on the tube, *a*, *a*, as is clearly shown in the various figures in the drawing. It will thus be evident that gas or other fluid passing in the direction of the arrows will when the valve, *e*, is off its seat, pass over the partition, *b*, and then pass off from the other end of the tube, *a*; but such gas, or other fluid, will be prevented passing in any other direction by the valve, *e*, being fixed all round, and gas-tight at its edges. *g*, is a metal cover which carries the handle, *h*; this handle has a screw, *i*, by which it is forced into or withdrawn from its seat or opening, *c*, Attached to the part, *m*, is a socket, *f*. On the other end of the screw, *i*, is formed a head which turns easily in the socket, *f*, consequently is capable of lifting the valve from, or closing it over, the opening, *c*. The handle I prefer to be moveable and therefore have omitted it in fig. 1.

Having thus described the arrangement of the apparatus, and the manner of combining the same, I would remark, that I usually cast the tube, *a*, *a*, in one piece, as is shewn in the drawing, but I do not confine myself thereto, for it will be evident, that a similar arrangement may be added to an ordinary piece of tube. And I would further remark, that I do not confine myself to the use of leather as the flexible material for covering the opening, *c*. What I claim as my invention is, the conbining the flexible valve, *e*, of any suitable material, with a tube, *a*, arranged as above described, into an improved apparatus for regulating the supply of gas to the burner, and for stopping off the same, applicable also as a cock in drawing off, or regulating, the flow of other fluids.—In witness whereof, &c.

Enrolled December 22, 1835.

PERSPECTIVE MADE EASY.

(*Continued from page* 141.)

Rule.—From the place of the point in the ground plan draw a line to the point of sight; and from the point where this line cuts the picture-sheet, let fall a perpendicular upon the line *a b* in fig. 2. After this, from the place of the point in the ground plan, whose perspective is wanted, let fall another perpendicular upon the line *a b*, in fig. 2; on this perpendicular set up the height that the point stands at in the elevation above the line *a b*, measuring this height from the line *a b* in the perspective view; then from the height so set up, draw a line to the point *c* in the perspective view, and the place where this line cuts the perpendicular let fall from the point in the picture-sheet, where the line drawn to the eye in the ground plan cuts it, is the perspective of the point wanted.

Example 1.—Suppose that we want to find the perspective of the top point *s* of the pyramid B. From *s*, in the ground plan, draw a line *sc* to the eye; and from the point *t*, where this line cuts the picture-sheet, let fall a line *tu* perpendicular to *ab*, in fig. 2. Then from the point *s* let fall a line *sv* perpendicular to *ab*, in fig. 2; on this line set up the point *v*, above the line *ab*, at a distance equal to the height of the top *w* of the pyramid, above the line *ab*, in the elevation, and from the point *v* draw a line to *c*, in the perspective view, and the point *u*, where the lines *vc* and *t u* intersect, is the perspective of the top point of the pyramid. As all the lines that run up the sides of the pyramid meet at the top, the perspective view of the pyramid is completed, by finding the perspective of the other ends of these lines, and joining as many of these points as are not hid by surfaces in front of them with the point *u*, and then join the perspectives of the points at the bottoms of the lines, the one with the other. The method of drawing the cube in front of the picture, and also the cube on which the pyramid stands, is fully sketched out in the engraving. The six-sided prism C is drawn in perspective, in the very same way as the pyramid—by finding the perspectives of the points at the ends of all the lines in it, and joining these perspective points.

Example 2.—To find the perspective of a circle, or any other curve, in order to illustrate this example, we shall take the circle on the top of the pillar D. Mark off at random any number of points, *xyz*, in the ground plan of this circle, and find by the rule the perspective of each of these points; then when that is done, connect the perspective points by a curve line, and this line will be the perspective of the circle on the top of the pyramid. The method of finding the perspective of the point *x* is sketched out in the engraving.

REMARKS.—1. Figs. 1, 2, and 3, are drawn on a drawing-board, in such positions that the lines marked *ab*, the one in the elevation and the other in the perspective view, are parallel to the line *a b*, which represents the picture-sheet in the ground plan; and these lines are drawn with the square applied to the edge of the drawing-board in the ordinary way; so in every instance where it is wanted to draw a line perpendicular to the line *ab*, in the perspective view, the thing is done at once by means of the drawing-square. And when the height at which any point stands above the line *a b*, in the elevation, is wanted to be set up on the line drawn perpendicular to *a b* in fig. 2, from the position of the point in the ground plan, you have only to apply the drawing-square to the place of the point in the elevation, and draw a line across the drawing-board, and this line will cut the perpendicular line at the proper height above *a b* in fig. 2, Now, it will be evident how the ground plan and elevation should be placed, in order to draw the perspective view easily.

2. Points, lines, and surfaces, in contact with the transparent plan, must be in the same position with respect to each other, and must have the same shape and dimensions in the perspective view that they have in the ground plan and the elevation, as the lines drawn to the eye representing the rays of light, do not converge till after they cut the transparent plane. This is the reason why the position of the point of contact of a line commencing at the picture-sheet is found in the perspective view, in the point where a horizontal line drawn from the place of the point in the elevation meets a line let fall from the place of the point in the ground plan, perpendicular to the line *a b* in the perspective view.

3. The line *ab*, in fig. 2, shows the intersection of the transparent plane with the horizontal surface on which the objects stand. If the objects do not stand on a horizontal surface, the line *ab*, in fig. 3, represents a horizontal surface drawn through the lowest point in the object; and *a b*, in fig. 2, shows the intersection of this horizontal surface with the picture-sheet. The lines marked *a b*, in the perspective view and in the elevation, need not be drawn when the position of the elevation is such, that the height of any point in an object can be set up on the line drawn perpendicular to *a b*, in the perspective view, from the place of point in the ground plan, by means of the drawing-square. But they (the lines marked *a b*, in figs. 2 and 3,) are of great use when the elevation cannot be got in a proper position, or when the elevation is drawn on a separate sheet from the perspective view.

4. As *c*, in the elevation, marks the position of the point *i*, as well as the point of sight, draw a line parallel to *a b*, through *c*, in fig. 3, till it cuts a line, let fall from the point *i*, in the ground plan, perpendicular to *a b*, in fig. 2, the point *c*, in the perspective view where these lines meet, is the position of the point *i*. The point *c*, in fig. 2, is also the position of the point of sight, for a point must be placed above, or below, or to one side of the point of sight, before the lines drawn to the eye which represent the rays of light from the point, and which mark its position on the picture-sheet, can converge or diverge betwixt the point and the transparent plane.

(To be Continued.)

MISCELLANEOUS LITERARY NOTICES.

BELGIUM.

A Society of Bibliophilists has been formed at Mons, who purpose publishing unedited literary and historical documents, and to reprint treatises which have become extremely rare; always preferring in both cases what is especially interesting to Mons or Hainault. The number of members is limited to twenty-five. The first number of its publication, which has just appeared, consists entirely of a MS. of 1681, hitherto unedited, treating of the government of Hainault subsequently to the death of the Archduke Albert, on the 23d of July, 1621.

It is now decided that Belgium is to have (or rather it already has) four Universities, two of which only are supported by the government, namely, those of Ghent and Liege. The ancient University of Lonvain is suppressed; but the magistrates of that city have made an arrangement with the archbishop of Malimes and the other prelates of Belgium, for establishing at Louvain the new Catholic University, lately founded with the sanction of the Pope. The fourth is the free University of Brussels founded by private individuals.

FRANCE.

Some years ago a bookseller at Orleans bought, at the sale of a private library, a valuable copy of the edition of Cicero, published in 1555, by Ch. Stephens. The margins are enriched with above 4000 corrections, written by H. Stephens and another learned man, who is distinguished merely by the name of John, perhaps J. Scapula. This book seems to be intended as the basis of a new edition, probably that which H. Stephens mentions in his "*Castigationes in quemplurimos locos Ciceronis*," which never appeared. We hear that the bookseller, who gave twenty francs for it, will not sell it under 1800 francs.

The antiquarian and historical publications of France are proceeding with great spirit. The first volume is just published of M. Michel's

collection of chronicles and other original and unpublished documents, relating to the reigns of William the Conqueror and his sons, a book extremely valuable and interesting to Englishmen. It forms an octavo volume, and contains large portions of the Norman Metrical Chronicles of Geoffry Gaimar, of an anonymous continuator of the Brut, of Peter de Langtoft, of Benoît de Sainte-More, and an Extract from a metrical Life of King Edward the Confessor. The second volume will contain the Latin lives of Hereward, of Earl Waltheof and his wife Judith, and of Harold, with an early Latin poem on the battle of Hastings, and the *Dict de Guillaume d'Angleterre*, by Chrétien de Troyes. At the end of this curious collection will be added complete Indexes and Glossaries.

The Commission Historique is also proceeding vigorously in its labours. Copies of its publications are shortly expected, and shall be duly noticed by us. M. Guizot, who is preparing a report to the king on the subject, has appointed Thomas Wright, B. A. of Trinity College, Cambridge, English correspondent of the Commission.

M. Raynouard, one of the first scholars of Europe, and well known for his work on the Poems and Language of the Troubadours, published in the years 1816—1821, with the title of "Choix des Poesies originales de Troubadours," has been ever since engaged on a work which he calls "Nouveau Choix des Poesies originales des Troubadours." Like the preceding, it will consist of six volumes, 8vo., of which the 3rd to the 5th inclusive will be occupied by a Dictionary of the Romane Language of the Troubadours, compared with the other languages of Latin Europe. The second volume, being the commencement of the Dictionary, is just published, and furnishes striking evidence of the extent and depth of the author's learning.

GERMANY.

The Book Catalogue of the Leipzig Michaelmas fair announces 3164 works, partly new, partly new editions, maps, &c. In the Easter Catalogue there were 3767, making together 6931. Among them are books and pamphlets on scientific and miscellaneous subjects: in the German language, 2800; in ancient languages, 208; in foreign living languages, 176; novels, 164; plays, 32; maps and charts, terrestrial and astronomical, 84; 178 translations from foreign languages, (of which 58 are novels); and 199 periodicals.

Neff, of Stuttgart, has announced a German translation of the eight Treatises written for the premiums bequeathed for the purpose by the late Earl of Bridgewater. Dr. Hauff, editor of the Morgenblatt, is named as one of the translators.

The house of Hallberger, of Stuttgart, has produced two volumes of a work which is professed, we know not with what truth, to be written by Prince Pückler Muskau, under the title of "Vorletzter Weltgang von Semilasso. Traum und Wachen. Aus den Papieren Verstorbenen." These two volumes which were published in September and to be followed in a few weeks by a third, comprehend the Author's Travels in Europe, and the succeeding ones will contain his observations on Africa.

Creuzbauer, of Karlsruhe and Leipzig, has commenced a picturesque work, entitled "Die Klassischen Stellen der Schweiz und deren Haupt-Orte in Originalansichten dargestellt." It will be completed in 24 monthly parts, royal 8vo., each containing 3 engravings on steel, by H. Winkles, from drawings by G. A. Müller, and a descriptive text by the veteran Heinrich Zschokke.

In 1824, Heinrich Meyer published the first portion of the History of Fine Arts among the Ancients, which related only to Greece. The continuation of that excellent work, which was ready for the press at the time of his death, in October, 1832, is announced for publication, under the superintendence of M. Riemer, librarian to the grand Duke of Weimar, by the title of "Heinrich Meyer's Geschichte der bildenden Kunst bei den Griechen und Römern." It is the result of many years' researches and observations, which suggested themselves whilst he was engaged in editing Winkelmann's Works jointly with Fernow and Schulze. Meyer was not eminent merely as an artist and a scholar: he was a genuine philanthropist. In his last will, after deducting a few legacies, he left the whole remainder of his property, amounting to about 33,000 dollars to the poor of Weimar. The interest of that sum is now applied to the relief of the poor of Weimar at their own homes, by supplying them in illness with medicines, and with medical and every other kind of attendance which they stand in need of. The Grand-Duchess takes upon herself the chief direction of this useful charity.

The works of J. E. Ridinger, whose unrivalled etchings of animals have always enjoyed the highest reputation, not only in Germany, but in foreign countries, have become so extremely scarce and dear, that we are glad to see an advertisement of the Bibliographische Institut, in Hildburghausen, announcing that it is in possession of the original plates, which are in excellent condition, and will publish them in monthly parts, each containing from four to eight plates, in imperial folio, at the very moderate price of about 3*s.* 6*d.* per number.

M. Hahn, at Hanover, has published the first part of a highly important geological work," Die Versteinerungen des Norddeutschen Oolithen Gebirges," *i. e.* The Petrifactions of the Oolite Mountains of the North of Germany, by Fred. Ad. Roemer. The

first number contains 12 lithographic plates in 4to. The work will be completed in three numbers, representing nearly 500 species of petrifactions, with a geological introduction.

The same house has published Monumenta Germaniæ Historica, from the year 500 to 1500, under the auspices of the Society for publishing the Sources of the Affairs of Germany in the Middle Ages, edited by Dr. Geo. H. Pertz, tom. iii. being the first volume of the laws of Germany in the Middle Ages.

"A young German army physician has discovered in a convent here a complete copy of the nine books of the Phœnician History of Philo-Byblius, which he translated into Greek from the Phœnician of Sanchoniatho. It is properly a chromicle of the town of Byblos; but as that town was in alliance with Sidon, and in the sequel became dependent on Tyre, the history of these cities is very circumstantially related. Neither are neighbouring cities, people, or dynasties neglected, or the coasts of the islands occupied by Phœnician colonies. The eighth book is particularly important; a catalogue of all the troops, war chariots, and ships of each town, and of each of the many dependent colonies. Only the colonies in Spain were independent, and allowed no persons from the mother country to visit their ports, except the merchants from Tyre." (Another letter adds that it will be published in Germany.)

The University of Göttingen has received a valuable present of Chinese books from Dr. Velthausen in London, which he purchased at Canton. There is with them a very large and accurate map of the Chinese Empire.

HOLLAND.

M. Noorda van Eyringa, who is well known to the learned world by his valuable labours in the Malay languages, has just presented to the king his Dictionaries and Grammar of the Languages of Kromo, Ngoko, Modjo and Karri (*query* Kawi?) in the island of Java. These works will be of infinite use to the Dutch civil and military officers, as well as to strangers visiting that island.

The Chevaler Rifaud, celebrated for his Travels in Egypt, Nubia, and the neighbouring countries, in which he spent twenty-two years, has brought back with him to Amsterdam a collection of more than six thousand drawings made on the spot, and embracing every thing connected with art that presented itself to his view. He has already commenced the publication of his Travels, and says, in the announcement, that he discovered, among other things, sixty statues, the smallest of which is of the natural size: and that he copied numerous inscriptions and tables of hieroglyphics.

PRUSSIA.

Two works, which might as properly be led one work, from their connection with each other, by Dr. Gottfried Schadow, Director of the Royal Academy of Arts at Berlin, have just been published, with the titles of Polyclet & Polycletes, or Measures of the Human Body, according to the Sex and Age, &c. German and French, 4to, with 29 lithographic plates, folio; and "National Physiognomies, or Observations on the Differences of the Features, and of the External Conformation of the Human Head," a continuation of Polycletes, 4to, with 28 lithographic plates, fol. They must be highly interesting to anatomists and artists.

"Der Preusische Staat, in allen seinen Beziehungen," compiled by a society of men of learning and friends of national topography, statistics, &c. under the direction of Baron L. von Zedlitz Neukirch, is destined to fill a desideratum that has long been felt. It appears periodically, and has now reached its 7th number.

RUSSIA.

A very important work has just been published by M. Schnitzler, author of the much esteemed "Statistique Générale de l'Empire de Russie." This new work is "La Russie, la Pologne, et la Finlande; Tableau statistique, geographique, et historique, de toutes les parties de la Monarchie Russe, prises isolèment. 1 vol. 8vo, 720 pages, with three plans.

On the proposal of the Minister of Public Instruction, the Emperor has been pleased to extend to the end of the year 1836 the scientific expedition of M. Feodorof, in Siberia, at the public expense, the chief object of which is to ascertain the exact position of several places between the 30th and 60th degrees of latitude.

Mr. A. J. Sjoegren, who has been travelling for some years in the northern parts of Russia, with a view to historical and philological researches, and who has collected a vast number of valuable MSS. and most curious information, is now gone to pursue his researches in the Caucasian provinces.

The Imperial Academy of Sciences has just lost its first vice-president, Mr .Henry Fr. Storch, privy councillor, and grand cross of several orders, who died in the night of the 13th of November, at the age of 69 years. He acquired deserved reputation by the publication of several useful works, among which are the Statistical and Historical View of the Russian Empire, and his Course of Political Economy.

SANDWICH ISLANDS.

Mr. Tinker, an American missionary, has commenced a periodical work at Honoruru, in Woahoo, one of the Sandwich Islands. This capital now contains 7,000 inhabitants, and the missionaries keep three presses going there.

TOPOGRAPHY OF INDIA.

COMPILED FROM VARIOUS WORKS AND MANUSCRIPTS,

BY THE EDITOR.

THE TOPOGRAPHY OF ARRAKAN.

It is difficult to please every class of our readers, and being apprehensive that the historical portion of our Topography may be deemed irrelevant to a Medical Journal, we shall give this portion of our labours to the Scientific Journal, and that which relates to climate, situation, diseases, &c. to the Medical.

ARRACAN.

(*Continued from page* 148.)

They live partly in houses of their own, and on their estates ; partly in cloisters, which are founded by their king, or great men (T), and generally very sumptuous : but they are all subject to one spiritual head, as before-mentioned. By them the children, both of the nobility and gentry, are educated in the knowledge of their religion and laws : and they are said to be exceeding hospitable to strangers. They have among them many hermits, like the *Joghis*, of the western parts of *India* ; who are distinguished into three kinds or orders, named *Grepi*, *Manigrepi*, and *Taligrepi* (U). These inflict on themselves very rigorous penances ; for which they are held in great esteem among the people.*

The government of *Arrakan* is chiefly in the hands of the twelve princes before-mentioned ; who are honoured with the title of kings, residing in the principal cities, in twelve royal palaces, with each a great seraglio, as well for their women, as those they educate for the king of all the rest, who keeps his court in the city of *Arrakan*.

This monarch affects as lofty titles as any of his neighbours ; stiling himself *Emperor of* Arrakan, *possessor of the white elephant* (X), *with the two* Kenekas, *and, by virtue of them, rightful heir of* Pegu *and* Brama. *Lord of the twelve* Boyoni *of* Bengal ; *and of the twelve kings* (meaning those in *Arrakan*) *who lay the highest hair of their heads under the soles of his feet*. His usual residence is in the city of *Arrakan*, but it is customary with him in summer to spend two months in a kind of progress by water to *Orietan*. In which he is attended by his nobility, in boats so artfully contrived and disposed that they appear rather like a floating palace or city than what they are. In this progress he does not omit to administer justice ; but hears causes as regularly as when at land. One pretence for this maritime journey is to visit the pagod of *Quiay Poragray*, their supreme deity ; to whom he daily sends a sumptuous dinner.

This, among many instances, shews, the kings of *Arrakan* to be very superstitious ; and this superstition frequently leads them into acts of the greatest barbarity. *Tosi* relates of one of them, that, being told he could not long survive his coronation, which is performed with the greatest pomp, he put it off, although the high-priest was already setting the crown on his head ; nor would admit that ceremony for the space of twelve years : but, being pressed to it by his lords, and not able to defer it any longer, he consulted a *Mohammedan*, to know whether there was any way to avert the omen. The *Musulman*, with an intent, it is said, to destroy those whom he reckoned enemies of his religion, told the king, that an electuary made of hearts, wherein were to be 6000 belonging to his subjects, 4000 of white cows, and 2000 of white doves, would protect him from the threatened danger. The king, relying upon this false information, built a house, the foundations whereof, to render it still more auspicious, were laid upon women great with child : and, on that occasion, sacrificed no fewer than 18,000 innocent persons, with a view to preserve his own life.*

We meet with no account of the descent of the kings of *Arrakan* ; but we learn from authors, that, to preserve the blood unmixed, they are obliged to marry their eldest sisters.† This monarch scarce ever goes out of his palace, above once in five years (‡), when he does it with great solemnity ; but passes his life there with his queen, and a great number of

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* Ovingt. p. 577, & seq.

(T) *Schoutin*, p. 335, says, their houses are either near the pagods, on rocks, or on little hills ; where they live like hermits, sequestered from the world. Although their air and gait is modest, yet one may discover pride in it.

(U) These names seem to be taken from *Mendez Pinto*. Other authors call them in general *Tali poi*, or *Talipoins*.

(X) This famous white elephant was wrested from the king of *Siam*, by him of *Pegu*, in 1567. It was taken by the king of *Tangu*, at the surrender of *Pegu* city, in 1599, and delivered to the king of *Arrakan* soon after.

* Ovingt. p. 579, & seq.

† Tosi ap. Ovingt. p. 582.

Methold ap. Purch. Pilgr. vol. 5. p. 1005.

(‡) Except we suppose in his progress, as aforesaid.

concubines. Every year the *sikkes* (Y), who are his favourites, cause twelve of the loveliest maidens to be sought for through the realm, and dressed in fine white linen. After this, they are exposed for six hours to the most violent heat of the sun, that they may sweat as much as possible. This done, other habits are brought them to put on, and their sweaty ones examined by persons appointed, who make their report; and the young ladies, whose sweat has no disagreeable smell, are presented to the king, and placed among his concubines. The rest are disposed of, with portions, to his courtiers. All the females are taught music and dancing, with whatever else may help to render them agreeable, in hopes of arriving to that dignity. It is said, that they who have obtained it, form themselves also to the exercise of arms; after which they are distributed into the principal apartments of the king and serve him for guards. *

The kings of *Arrakan* were formerly almost continually at war with the great *Mogol*; but never came to a set battle. for they do not care to hazard their troops much†. These monarchs, however, for the vastness of their treasure and military strength, are as considerable as most eastern princes. About 150 years ago they became famous by their wars, and much enlarged their dominions by the conquests they made both in *Bengâl* and *Pegu*. However, it is observed, that they were generally unsuccessful in their wars against the *Portuguese*; who, in 1605, defeated the king's fleet, consisting of no fewer than 540 sail (or barks); and, not long after, he was forced three times to retire from before *Siriam* (now belonging to *Pegu*), though he attacked it with a fleet of 1200 sail, and an army of 30,000 men, accompanied with 3500 great and small cannon ‡. However, the king of *Rakan* (or *Arrakan*) by degrees humbled them, as will be related hereafter.

The first account we meet with of the affairs of *Arrakan* is about the year 1569; at which time the king of *Pegu* (of the *Barma* or *Brama* race), growing very powerful, sought, by all manner of ways, to subdue that kingdom. But he was not able to compass his design: for first, he had no fleet to transport an army by sea; whereas the king of *Arrakan* could arm 200 gallies in his defence: and, in case he should invade that country by land, the inhabitants were ready, by means of sluices, to lay the same all under water, and either drown their enemies, or impede their march. However, at that time, the *Portuguese* of *Chatigan* having slain the governor of that city, which belonged to *Bengâl*; and it being made an article of the accommodation which soon after took effect, that the chief commander of the *Portuguese*, who had then eighteen ships in the port, should depart the place with his vessel; the king of *Arrakan*, to strengthen himself against his neighbours, invited the captain to come into his dominions*. By this means the *Portuguese* first found an introduction into *Arrakan*; where, by degrees, they gained a considerable footing: which they lost again, at length, by their insolence and crimes.

These *Portuguese*, however, proved of great service to the king of *Arrakan*; for, in 1581, the king of *Pegu*, having at length procured a fleet of 1300 sail resolved to conquer that country. With this view he sent that numerous armament, under the command of the prince his son, towards the *Arrakan* coast. The prince being informed, in his passage, that two *Portuguese* galliots had taken a ship of *Pegu*, richly laden, he detached sixteen of his best sailors to attack them. The galliots received them bravely, and disabled several of them: till seeing the whole fleet coming down upon them, they made the best of their way into the bay of *Arrakan* †, which prevented the prince from making a descent.

After this, *Arrakan* seems to have been freed from any attempts on the side of *Pegu*, whose arms turned against other neighbouring nations. Nor did the king of *Arrakan* take that opportunity to attack his most dangerous enemy, for fear of drawing back his resentment upon him. But at length the power of *Pegu* having been greatly exhausted by long wars, particularly with *Siam*, several of the bordering kings, taking advantage of *Branjinoko's* distress, entered into a league against him. Among the rest *Shilimi Sha* (A), *Arrakan*, was one. This prince, in the year king of 1598, laid siege to the city of *Pegu*, and was joined soon after by the king of *Tangu*. But being called away for a while about some other affairs, he left the continuance of the siege to the king of *Tangu*: who made so good use of his time, that, before the king returned, he had gotten *Branjinoko*, with all the royal family, into his hands, and carried off almost the whole treasure of the captive prince amounting to an immense value; leaving behind above three millions in silver and other metals, which he thought not worth while to take with him.

SHILIMI Shâh, coming back to *Pegu*, took the kingdom into his possession, with the silver which the king of *Tangu* had left for him: but not brooking to be so tricked by his good ally, who had agreed to divide the spoil, he sent to demand a farther share, with the white elephant, and the captive king's daughter; he likewise required that the king himself should either be sent to him, or slain; threatening otherwise to invade *Tangu*. To avoid this visit, his demands were complied with; the king's brother, and two of his sons, sent also; and the dethroned tyrant was put to death.

(To be continued.)

* Schout. ubi supr. p. 233.
† Schout ubi. supr. p. 228.
‡ Jarric. ap. Ovingt. p. 578.

(Y) According to *Ovington*, p. 579, the twelve governors, stiled kings, are obliged to pick out twelve girls every year, within their provinces, and educate them, at the king's charge, in their seraglios, till they are twelve years old; at which age they are carried to court, and chosen by the smell of their sweaty garments. *Edourdo Barbosa* relates to the same purpose.

* Cæsar Frederic ap. Purch. pilgr. vol. ii. p. 1720.
† De Faria Portug. Asia, vol. ii. p. 369, & seq.

(A) Called, afterwards, *Shilimika*, which seems the more natural name of the two.

Thu. 6, 1836
Sept.

THE INDIA REVIEW

OF WORKS ON SCIENCE

AND

JOURNAL OF FOREIGN SCIENCE AND THE ARTS.

EMBRACING

MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS, &c.

REVIEW.

Some enquiries in the Province of Kemaon relative to Geology and other Branches of Natural Science, by Assistant Surgeon JOHN McCLELLAND, *Member of the Royal College of Surgeons, in London, and of the Medical and Physical Society, Calcutta, Oct. pp.* 384.—THACKER & Co., CALCUTTA.

The second chapter of Dr. McClelland's work opens with a general description of the district. He introduces his reader to the pass of Burmdeo, the capital of Rohilcund, ninety miles north, or eight marches from Bareilly; he represents the spot as being in the form of an amphitheatre, surrounded by delightful mountain scenery. At a narrow outlet emerges the great northern branch of the river Gogra, watering the plains of Rohilcund and Oude, until it joins the Ganges near Ghazeepore.

Three marches further north, our author brings us to Lohooghat. The first march is over a rugged group of mountains 5,000 feet above the sea. From the summit the view of the Himalaya is intercepted by a still higher range. The traveller descends to Belket; the country between Belket and Burmdeo is represented as uninhabited. Dr. McClelland states, however, that a few huts may be found on the elevations, but the valleys are uninhabited at least during six months in the year. We wish our author had been particular in specfiying the months, we suspect they are the four preceding and the two succeeding the termination of the rains. Thus it is that the rudest inhabitants of the earth are made wise by experience and observation. Malaria, during the periods which we have alluded to, exists in all its virulence and drives the lowlanders to the highest elevations.

Those who are sceptics as to unhealthiness from ditches and low marshy spots, let them learn a lesson from the examples of these mountaineers. Our author next ascends to Choura Pany, which is situated on a ridge verging along the base of the Himalaya chain: from this spot the snowy peaks burst upon the view. Dr. McClelland speaks of the scene as indescribably magnificent. Mountain scenery in all countries exalts the imagination and rivets man into profound admiration; but that of the mighty Himalaya is grand beyond description. The first time we saw these lofty ranges was on the occasion of our accompanying the army which invaded Nipal. The scene on that occasion can never be erased from our recollection; as we sat upon one of these mighty elevations, we could look down to an immense depth and see the army of many thousands marching up almost a perpendicular height, so rapid are the mountains in some places. The lofty pines and green oak woods hid the moving body, and then they would be seen again in immense numbers on perilous ridges, the azure clear Indian sky, the brilliant rays of the sun reflected from the British bayonet, the well known shout of a marching army, and the buz of camp followers echoing along the deep dells, awakened a thousand thoughts and aroused a thousand feelings, and then onward shone the brilliant tops of the snowy height, with which our author is now enraptured.

The fact is, that in no part of the world a more sublime sight can be witnessed than the lofty Himalaya, played upon by the brilliant rays of a tropical sun. It appears that from Choura Pany the view is circumscribed. Our author ascends the neighbouring heights. The lowest altitude of an uninterrupted chain of lesser summits, extending at least four hundred miles, is in Dr. McClelland's opinion about six thousand "feet above the line of perpetual congelation, which in this latitude is about twelve thousand feet; consequently, the lowest peaks in this portion of the Himalayas must be somewhere about eighteen thousand feet; while many of the higher summits approach an elevation of twenty-five thousand feet above the ocean. Careful attention to the changes which the physiognomy of such mighty elevations undergo, is an object of the highest importance; and was, I believe, first suggested by Humboldt: but in order to afford much interest in a moderate space of time, constant observations of the most accurate and systematic nature would be necessary."

Our author says that he does not pretend to any thing of this sort; but prefers giving a plate, and has ably sketched a general outline of the chain from the highest summit of Choura Pany. Dr. McClelland states that he took the relative altitudes of the different peaks with a common Gunter's quadrant, furnished with two right vanes and a plummet. In describing the first peak the height of the eastern extremity of the range was 2° 45′; western acclivity, 24°; eastern declivity 60. Our author describes it to have an unsteady overhanging character falling towards the east; surrounding and subordinate peaks are pointed and bristling. The height of the second peak 3°; western acclivity, 44°; eastern declivity, 55′; character, pyramidal and pointed.

The third the height of the peak 3°; eastern acclivity, 29°; western declivity, 50°; near the summit; character, wedge-shaped. The fourth height of peak 2° 45′, eastern acclivity, 47°; character resembling a dome. The lowest snow at the apparent base of the fourth peak 1° 17′. The same at the apparent base of the first peak. Our author observes that,

"From these kind of observations also a formula may be derived for calculating inaccessible heights: the lower limit of perpetual congelation being determined. Here, as has been found by Webb and other travellers, that limit is about 12,000 feet; and its height at the base of (*b*), for instance, was 1°; deduct the height of the place of observation (6,000) from the height of the lowest snow (12,000), and the difference is the value of a degree of height; accordingly, the peak (*b*) must be somewhere about 24,000 feet high*."

The plate which illustrates the foregoing does great credit to Dr. McClelland as an artist, and also to Mr. Bennett who drew it on stone; and it proves that lithography and printing here will soon be equal to work done in Europe. The following passage will give the readers some idea of our author's style. It is chaste and eloquent, for which Dr. McClelland's countrymen of the emerald isle are so justly celebrated.

"The hours of the day, at which these awfully interesting altitudes are seen to most advantage, is either before sun-rise, or after sun-set; when their soft crimson forms are barely relieved from the glowing tints of the sky, by the golden lights that play along their varied outlines.

From the position at which these observations are supposed to be made, the mountains which intervene between the snowy range and the eye, vary in their respective altitudes from six to twelve thousand feet. The different branches of the river Gogra are sometimes seen, but often only heard, in furious torrents, rushing down the river valleys, which divide the mountain groups from each other. The great valley of the Gogra is seen a few miles to the east: the river running from a north-easterly direction, and receiving a large branch that comes from the north-west. The north-eastern branch continues to mark the boundary between the kingdom of Nepaul and the province of Kemaon. The western branch is soon discovered to be formed of two rivers: one of which comes from the north, and the other from the north-west, receiving its origin in the mountains, east and north-east of Almorah, in conjunction with the Pindur, or third branch of the Ganges.

* Notwithstanding the confidence we are ever ready to repose in mathematical rules in the elucidation of the laws of nature, yet they are often as imperfect as the limited observations on which they are founded. Thus there is reason to believe, that the inferior limit of perpetual congelation is much more elevated on the S. W. acclivity of the Himalaya than has been assigned to it by Captain Webb. There is reason to believe, that the inferior *annual* limit of snow varies so amazingly, according to peculiarity of seasons, that a series of years only would afford accurate calculations. See the Chapter on Climatology.

The valleys of these rivers sink to the depth of five or six thousand feet below many of the adjoining summits; but the general height of the mountains above the valleys throughout the district, is from two to five thousand feet.

The mountains are generally massive; and differ in their more minute outlines, according to the nature of the rocks of which they are composed. Hornblende-slate forms mountains, whose acclivities rise abruptly, at angles of from 65° to 35° with the horizon. Mica-slate and gneiss, as well as clay-slate, present acclivities that vary from 60° to 30°. The mountains composed of these rocks are usually wooded; and their summits are round-backed, undulating, or conical.

Limestone mountains are here characterised on the great scale; by abrupt rugged acclivities, mural precipices, lofty, varied, and picturesque summits, cascades, and subterraneous streams, deep ravines, and narrow inaccessible valleys, transition clay-slate forms barren, round-backed mountains; which are uniform in their appearance, and intersected by few ravines.

There is also a genus of rocks related to the Dolomite family, which deserves to be mentioned; as stamping a peculiar character, upon numerous mountains of the district: they form lofty caps, and shields; usually disposed in saddle-shaped strata, presenting smooth, and often inaccessible declivities; which are too abrupt to afford, even vegetable existence, except to grass and lichen: while ravines and low places, situated at the base of such mountains, are strewed with rounded masses, which have been precipitated from above.

The district which is to form the subject of the following pages, is embraced by the latitudes 29° and 29° 45′ N. Long. 79° 55′ and 80° 20′ E.; and lies on the western side, of the river district of the Gogra. Having thus defined the geographical limits, to which only it is intended, that the following pages shall refer; it may be proper to recapitulate such of the foregoing remarks as apply only to this limited space, and to add such further observations, on the general characters of the district, as may lead the way to the more minute details respecting the rocks and minerals of which it is composed, and of the relative connexion of these to each other.

It has been said, that the mountains of certain rocks, as gneiss, hornblende-slate, &c. derive peculiar outlines from the nature of their composition. These distinctive characters may even be traced to more minute particulars. Hornblende-slate, for instance, appears to have much more effect, in resisting the destroying power of the atmosphere, than either gneiss or mica-slate: the latter rocks may therefore be distinguished from the former one, by the numerous white patches of naked surface, whose active state of decomposition prevents the growth of vegetable matter. The mountains of gneiss may again be distinguished from those of mica-slate, by the overlying masses of granite; which have been denuded by the decay of the softer rock, in which they once existed as beds, or central nuclei: enormous masses of this kind are found throughout the gneiss district, which extends from the ruins of the ancient city of Chompawut, in a north-westerly direction, probably for a hundred miles; I have traced them myself for forty miles.

The valleys, formed bv the different tributary branches of the Gogra, divide the district into sections. The first is that deserted tract that lies between Burmdeo pass and Belket. The second is a more important section; and extends from the river Ludhoo, at Belket, to the Ramessa, and is chiefly composed of primitive rocks. A ridge of granite composes the centre of this section; and forms occasional elevations of nearly eight thousand feet. Gneiss, hornblende-slate, mica-slate, and clay-slate, are the other principal formations, which occur in this section.

The third natural division is that which lies on the north of the Ramessa river, and between the rivers called Mahi Kali and Surjee; embracing some fine, though small valleys, the principal one of which is the valley of Shore; and to avoid the confusion of names, it may be proper to use this term to distinguish the adjoining portion of the district.

Of the mountain rocks that occur in the Shore section, primitive clay-slate is the oldest, and forms the basis of this part of the district, and ascends to elevations which are occasionally above 8,000 feet: primitive, transition, and floetz limestone also occur in succession, and bestow their peculiar stamp on the aspect of the neighbourhood. The mountains are here more majestic than in either of the other sections; each individual, standing almost detached from the group to which it belongs, and bearing some well-marked character, which leaves on the mind, an impression not easily effaced. Thus we find, in the Shore district, every mountain distinguished by some traditional name, derived from a sacred rock, or ancient temple, which usually caps the summit. At certain festivals, crowds of the superstitious population resort to these romantic caves and temples; and on more private occasions, the solitary devotee often ends his life, in the attempt to gain an almost inaccessible summit, in order to invoke the protection of some grotesque representation of the deity, to which the mountain is dedicated. How forcibly the selection of such localities, for religious purposes, attests the influence of what is awful in nature, over the mind of man, even in his rude and nearly savage state.

Our author next proceeds to give a table exhibiting the mountain rocks of the district in the order which they occur. We shall quote this, as a proof of his systematic arrangement.

TABULAR VIEW OF THE MOUNTAIN ROCKS THAT OCCUR IN KEMAON.

Primitive Rocks

1 Granite, containing beds of ferruginous slate.
2 Gneiss, containing central nuclei of granite, and nodules of hornblende.
3 Hornblende-slate,
   - var. a, granular, containing beds of gypsum and chlorit slate and porphyritic green stone.
   - ,, b, coarse slates.

   Mica slate, containing beds of gypsum.
4 Clay-slate, containing beds of quartz gypsum.
5 Limestone, containing splintry hornstone and beds of green stone.

Transition Rocks.

1 First formation suite,
   - oldest transition limestone,
   - slate and limestone,
   - coarse magnesian limestone,

   containing traces of fossil remains of zoophytes.
2 Common dolomite or steatitic sandstone, var. weathered, containing traces of zoophytes.
3 Transition slate.
4 Transition limestone, stratified, containing beds of overlying,
   - Granatine.
   - Fibrous limestone.
   - Talc.
   - Common Serpentine.

5 Compact dolomite, granular, passing into calcareous oolite splintry,
6 Siliceous oolite.

Floetz Rocks....

1 First floetz formation,
   - a, Copper slate.
   - b, Alpine limestone.
   - c, Tabular limestone, containing distinct concretions resembling small fishes. Slaty magnesian limestone.

2
   - Argillaceous sandstone.
   - Slate-clay.

3
   - Calcareous grit stone.
   - Vesicular limestone.

Alluvial Rocks ..

1 Mechanical alluvial deposites,
   - Nagelflugh.
   - Siliceous earth and gravel.
   - Aluminous earth.

2 Chemical alluvial deposites,
   - Calc Luff, lowermost layers, containing leaves of unknown plants, succeeded by beds of osteocolla, and the leaves of known species.
   - Calc sinter.

While we perfectly agree with our author that in describing a district the geologist should not be bound down to any particular system, those of our readers who will only look through that splendid work, Thomson's Annals of Philosophy, and see the disputes and angry feelings engendered on account of rigid adherence to this and to that system, will bear the truthof that position. But, notwithstanding, system is indispensable tothe ends of this science, which can only be promotedby carefulobservation; and hence we establish a system of our own. The geognosy of Werner has peculiar claims for admiration on this account; void of those lofty pretensions which belong to speculations, it has established several principles which facilitate the labours instead of obstructing the geologist in his researches. We also admit the sentiments on this subject of that celebrated mineralogist, Mackenzie, that that system which developes the great laws of nature, and is substantially improved by the examination of her works, is of all others the best calculated to promote every science; and accordingly we find that mineralogy has made the most rapid advances wherever this has been fairly adopted. Formerly mineralogical enquiries produced nothing more than a mere catalogue of localities; but now many relations of individuals have been distinctly determined, others are daily ascertained, and the most doubtful are now becoming accurately known.

Dr. McClelland thinks that it is best to follow no artificial method, such being foreign to the purpose of practical geognosy. He adverts to Werner for instance, having found in the mountains of Saxony, that hornblende-slate occurs in subordinate beds in clay-slate; seldom in gneiss or in mica-slate, placing it in his system in consequence with primitive trap, assigning to it a position between primitive limestone and the oldest porphyry. In the Riesengebirge, Raumer found the same rock to prevail to a much greater extent than it had been found by Werner in the Ergeberg, and its geognostic position was found to be between granite and gneiss which led to Raumer's proposition of a new arrangement of mountain rocks. Now Dr. McClelland states that it is found in Kemaon, resting on gneiss, into which it passes on the one hand and into mica-slate on the other; and from the extent and position our author would rank hornblende-slate next to gneiss among the mountain rocks that compose the eastern frontier of the province. Hence Dr. McClelland infers the necessity of being free from the influence of arbitrary systems.

Now all these differences may occur to which our author has alluded, and yet the influence of the best established system have its weight and importance of leading to results, which without system never would have been obtained. There can be no doubt as to the mineralogical connection between the greenstone and the serpentine,—of the gradation between the two, and of the perfect character of each substance at the extreme points of both. As far as composition is concerned it is known that hornblende is an ingredient in both rocks; but there are essential differences both in their chemical nature and chemical composition: but because of the transition which occurs in different spots, we do not argue that the systematic arrangement is affected to a degree to bring the geologist into bondage from the adoption of a system, as to lead him into difficulties. Dr. McClelland's intelligence has communicated an important fact without proving that a system is arbitrary, but rather that all systems are open to improvement as we advance in knowledge. Now what has been the effect since the days of George Agricola, the systematic mineralogist who first investigated the external characters of minerals, who was able to determine them with a degree of accuracy by adopting a system. Cardan soon wrote a treatise improving upon that system. Then came those by Becher, Bromel, Cramer, Linnæus, Pott, Wallerius, Cronsted, the illustrious Werner, Rome, d'Lisle, Abbe, Haüy, Kirwan, &c. each correcting errors and improving upon the system of his predecessor, so that with the science is system rapidly advancing towards perfection and is to be thus encouraged. But we must hasten to conclude, lest Dr. McClelland's interesting work should occupy more of our space than we can spare for a single number. We shall conclude our review in the next.

Art. II.—Cultivation of Cotton, By W. BRUCE, *Esq. Remarks on the culture of Cotton in the United States of America, Capt.* BASIL HALL'S *Travels. Remarks on the best method of cultivating New Orleans Cotton, Ibid. Regarding the cultivation of Cotton, Ibid. On the cultivation of Cotton in Central India, By Baboo* RADHAKANT DEB. *Observations on the culture of Cotton in the Doab and Bundlecund, By* W. VINCENT, *Esq. On the artificial production of new varieties of Cotton, By* H. PIDDINGTON, *Esq. On the method used in Cayenne to preserve the Cotton Plant. On a specimen of Cotton gathered in the Boglepore district from a shrub in its wild state, by* F. HUNTER.

Use of the Sawgin, by F. MACNAUGHTEN, *Esq. Cotton of Ava. Cotton of Cachar, by Capt.* S. FISHER. *On Cotton grown in Cuttack and its staple for spinning, by* M. T. WEEKES. *On the native Cotton produced in the Ganow Hills, by Capt.* A. BOGLE. *Report on specimens of Cotton reared by Col.* COMBS, *at Palaveram. On the cultivation of Upland Georgia Cotton at Allahabad, by Mr.* W. HUGGINS. *On the cultivation of Pernambuco Cotton at Tavoy, by* W. MAINBY, *Esq. On the cultivation of Sea Island Cotton in the district of Cuttack. On Upland Georgia and Sea Island Cotton. Transactions of the Agricultural & Horticultural Society of India—Vol.* 11. 1836.

The importance of the articles under review is best shewn by the great national benefit which has resulted to America from the capital and skill which have been employed in the cultivation of cotton. The quantity of American cotton exported annually is, 294,310,115 lbs., the value of which is 29,359,545 Spanish dollars, £ 6,330,651; whereas the total export from all India was only 68,411,015 lbs., the value of which, at 25 shillings per maund of 80 lbs., would be £1,068, 922 ; so that the importation of the American cotton in Britain has increased from about 19,000 lbs. to 294,000,000 lbs., and the increase of the Indian cotton is but 68,000,000, lbs. Our information is derived from Mr. Crawford, who is of opinion, however, that, supposing the same capital and skill had been employed in the cultivation of cotton in India as was employed in the United States, a similar increase in the exportation of Indian cotton might have taken place. The cultivation of cotton hitherto has not been considered of primary importance ; the ordinary kind cultivated has been for the most part the coarsest, because they are the most easy to rear ; the finer varieties are very rare. The great objection to the Indian cotton has been owing to its want of strength in the staple, always dirty, short in fibre, coarse, and the seed adheres very closely to the wool. The consequence is that there has been no cultivation of cotton by Europeans in Bengal. It has been supposed that the province of Bengal is not fit for the cultivation of cotton, because it has afforded none for exportation ; but this is entirely owing to a want of skill and attention ; for instance, there is a superior growth of cotton extending about forty miles along the banks of the Megna and about three miles inland : it is from this the fine muslins of Dacca are produced. This happens to be cultivated by the natives alone. Dr. Roxburgh has given an account of the Dacca cotton ; he designates it a variety of the common herbaceous annual cotton of India, and states that it is longer in the staple, and affords the material from which the Dacca muslins have been always made. But that good cotton can be made in Bengal, has been fully shewn by Mr. Piddington, who has exhibited samples of cotton; the field growth of his estate, forty miles north-east of Calcutta. This cotton thrives so luxuriantly as frequently to oblige him to root it up. Mr. Piddington was of opinion that there was no fear of its degeneration, as he had cultivated it for some years. Some Liverpool merchants examined this cotton and declared their decided opinion that it was a very useful description, clean, and fair in

colour and staple, and, moreover, that it would meet with a ready sale in the Liverpool market at 6½d per pound; whilst the average quantity of other East Indian cotton, commonly sold under the denomination of Surat and Bengal, was not worth more than 5d. per pound, and that of nine-tenths of the cotton grown in the United States of America, is of the value of 6¾d per pound. We proceed however to allude to facts; to shew that Bengal as well as India generally possesses climate and soil to afford cotton in the greatest quantity and in the greatest perfection, capable of producing sufficient for the consumption of the European market. All that is desiderated is the proper application of European skill and capital. Fifteen thousand bales a week of cotton have been consumed annually in Liverpool, and the consumption of cotton in Bukár is increasing with extraordinary rapidity. We are in possession of some interesting documents regarding the introduction of the Sea island cotton. The introduction of cotton into Georgia and Carolina has always been deemed a subject of paramount importance. For domestic purposes it appears that cotton was introduced from Virginia into Georgia anterior to the revolutionary war. At this period Sir R. Arkwright had invented a spinning wheel, and cotton became a matter of deep interest in England. It rose in price in consequence; its various qualities began to attract notice, and the world was searched for finer kinds. The island of Bourbon was also found to produce them, which resembled a green seed cotton with which twenty acres had been cultivated by Col. Dellegal upon a small island near Havannah before the revolution. The seed however from Bourbon, strange to say, could not be naturalized at Georgia. The Sea island cotton was introduced directly from the Bahama islands into Georgia. The quality of the Bahamas cotton was then considered among the best grown; it was first cultivated in the spring of 1787 upon the banks of a small rice-field in St. Lonan's island. The land was rich and warm, the cotton grew large and blossomed, but did not ripen to fruit; it however ratooned and grew from the roots the following year. The difficulty was now over; the cotton adapted itself to the climate, and every successive year from 1787 saw the long stapled cotton extending itself along the shores of Georgia, and into South Carolina, where an enlightened population, then engaged in the cultivation of indigo, readily adopted it; all the varieties of the long staple or at least the germ of those varieties came from the seed; differences of soil developed them, and differences of local situations are developing them every day. The same cotton seed sown in one field will give quite a black and naked seed; while the same seed, sown into another field, different in soil and situation, will run into large cotton with long boles and pods, and with seeds tufted at the ends with fuzzy. A particular kind of cotton, equal to any in the South Sea islands was cultivated in the neighbourhood of Sylhet hills. The cotton at Madras is generally valued at 100 rupees per candy, but Tinevelly and Ramnad cotton is valued at 120. As a proof what may be done on this side of India, a gentleman, connected with Gisborne and Co. who resided at Benares, got a few seeds of Brazil cotton, which he cultivated in his garden there, for two or three successive years and produced three bales of cotton at last which he sent down to Calcutta for shipment to England. Gisborne shipped them to London, where they sold for a shilling a pound, at the time that Indian cotton was generally between four pence and five pence. Richie and Co. of Bombay imported seeds from the Brazils and America; but they did not succeed there in improving its culture and preparation for the market. The cotton greatly deteriorated, and some of the seeds did not come up; we believe, however, in the foregoing instances, there were no superintendents or agents acquainted with the culture of American cotton; for very fine cotton has been produced at Salsette by Dr. Scott equal to Bourbon cotton. There is also a village near Manyrole in Kattywur, called Labarcoire, which produces some of a very fine quality indeed, which is cultivated by natives

entirely. We have thus given the foregoing preliminary remarks more with the view of shewing the importance of the papers under review than of supposing we are enlightening the cotton cultivators of the country; but be it understood that a reviewer always should, and, in fact, must so feel that he is writing for the information of those who are ignorant of the subject. We shall therefore first look into additional facts, gleaned from the report of the Select Committee of both Houses of Parliament, as to the cultivation of cotton; evidence sufficient to shew that by improved cultivation and by selection of seed, the Bombay Cotton could be produced to equal or nearly to equal the Sea island cotton, and therefore that as good and useful cotton can be grown in the East Indies as in America, and the cotton from this or Kidney seed will produce four times the quantity which the present growth of cotton does, and be much more easily cleaned. As to the question of climate, the cotton shrub is indigenous throughout the peninsula of India, from Ceylon in the south, to the foot of the Himalayah mountains in the north; and various kinds have long been known to the native cultivators, viz. annual, biennial, and cotton of several years' duration; some kinds scarcely reach the height of one foot, others attain ten or twelve feet, and some a still greater height. The species which is in cultivation in India is an annual shrub, a variety of the green seed kind, yielding a white pod. Of this there are subvarieties, of some of which the wool is more easily separated from the seeds than of others. Some of the cotton plants have brown, yellow, ash-coloured, and iron-grey pods; the seeds of some species are black, green, and red.

The introduction into India of new and better species, and of improved modes of preparing cotton for European markets, has at various times been attempted. The Sea island cotton, Barbadoes cotton, Brazil cotton, and Bourbon cotton, both of the green seed and black seed varieties, became objects of experimental cultivation in various parts of India. Success has not generally attended these endeavours; but we think this is owing to the little attention native cultivators have given to the subject, and on account of experiments principally on a scale of commercial speculation which have been conducted by Europeans having been confined to the Bourbon species. The objection to the Indian cotton has been shortness of staple and of its not being sufficiently cleansed from the seeds, leaves, and other matters, to remedy which the Court of Directors obtained from America patterns of the most approved machines in use in Georgia and Carolina, for separating the wool of the cotton from its seeds; and they also, in the year 1813, engaged the services of Mr. Metcalfe, who had for some years carried on the business of a cleaner of cotton in Georgia, who, after a residence of some time in India, finding his endeavours to induce the natives to use American machines were fruitless, gave up his employment. The Marchioness of Hastings procured from England, in the year 1823, a supply of seeds of the Brazil and Barbadoes cotton, which she cultivated at Barrackpore, and distributed the seed among the husbandmen in the neighbourhood. The cotton thus raised was delivered to the commercial residents at the factories of Santipore and Huripaul, and wrought into muslin. Bourbon cotton was cultivated in the province of Tinnevelly; but it appears the climate was opposed to the extension of the culture. Cotton has been grown to some extent in the southern Mahratta country, but of an inferior quality to the Guzerat cotton. It is supposed that long-stapled fine cotton is never grown in any country except in the immediate neighbourhood of the sea. The cotton of Dacca is grown within seventy miles of the sea. The Sea island cotton is grown in the immediate neighbourhood of the sea. The Bourbon cotton is grown there; and the fine cottons of China are grown also in the immediate neighbourhood of the sea. The common annual cotton will come to maturity in four or five months; but in cultivating the finer kinds in India and elsewhere, they may, by care, be made to ratoon, that is, to grow from the roots, and then the varieties

which are annual will become perennial, and be cultivated for three, or four, or even five years; but that is not the general practice. In India the seed is sown, the plant grows up, the cotton is taken from it, and it perishes within the year. The greater part of the American cotton is annual; that of the Sea island is perennial. The Upland or termed Georgia short stapled cotton has been improved by continually changing the seed, using fresh seed every year. The plant degenerates after one year's growth. The growth of the United States is confined to two qualities: Sea island and Santa, or long stapled growths. All the rest are short stapled, and denominated Upland. The Santa, as well as the Sea island, are superior to all other growths. The cotton of Brazil is superior to short stapled American cotton generally, but not superior to Santa or Sea island. India cotton, being short stapled, is governed in price by the American growths of short stapled cotton; and the prices of India generally bear a proportion of two-thirds of the value of American. When the latter sells at six pence per pound, Indian cotton has been at three pence to four pence half-penny per pound; when American cotton sells for ten pence to one shilling per pound; when American has been eighteen pence to twenty-one pence per pound, India has sold for twelve pence to fifteen pence per pound. The great inferiority of price of the Indian cotton is owing to its being shorter in staple and having more dirt and waste in being manufactured. Indian cotton is considerably shorter in staple than the short stapled American cotton: it is inferior generally both in regard to staple and requires more labour to clean it. Indian cotton in Europe at 3 pence per pound, with any sort of cleaning, affords a profit superior to the cotton at 6 pence per pound which is already cleaned. Spinners say that they would rather have cotton from India and clean it in Europe, than have it tampered with in the cleaning; either from their ignorance, or some circumstance, the fibre of the cotton has become injured in the cleaning. Nothing equals the screwing of Indian cotton. The violent application of the screw does not injure the fibre of the cotton, it expels the external air; and cotton will keep with all its qualities for very many years. It is necessary to clean it in all cases previous to its manufacture. The best species of Egyptian cotton is superior to every description of cotton that is grown except the Sea island and long staple American cotton; and cotton dealers in Europe are now receiving from Egypt an improved culture from Sea island seed, which is greatly appreciated by manufacturers and promises to rival the growth of the Santa cotton. The finest Indian muslins are made from the common cotton of the country, the short staple cotton grown in Bengal. The whole of the manufacture being by hand spinning, there is a greater tension from the moisture which the hand gives them, than can be had from anything in the shape of machinery; a fine yarn can be produced by hand spinning from a short staple which from spinning will not touch at all. The thread of muslin is spun by the hand in India. In America cotton undergoes great improvement in respect of cleaning. The Brazilians have fallen off in the cotton. Imperfection in the mode of cleaning very materially affects the value of cotton; the least particle of dirt or dust in cotton is sure to break down the thread. It is possible to clean cotton as perfectly after it has been imported in Europe and packed a number of months, as it is at the time it is first taken from the ground. The cotton is not injured from the presence of dirt, nor by confinement on board ship; cotton has been kept for twenty years and then worked remarkably well. The inferiority of the Indian seed is known by stripping it of the husk; pressing the thumb upon it breaks it like dirt. The Kidney, the Brazilian seed stripped and pressed, oil appears, which shews its superior strength. The Pernambuco is the strongest, and produces the fullest quantity and quality of all seeds. Cayenne and Surinam are also very good, and contain oil. The Brazilian seed, considering quantity and quality, and treating it with attention in the East Indies, would prove superior to some and equal to any but the Sea island, which is grown from Persian seed taken from the Bahama islands. It

is a very pure cotton, having a very fine silvery gloss upon it, and is fit for any purpose, the staple being remarkably strong, fine, and long. We have exceeded our space: we shall proceed with the subject in our next.

Art. III.—Journal of a Tour through the island of Rambree, with a Geological Sketch of the Country, and Brief Account of the Customs, &c., of its Inhabitants. By Lieut. Wm. Foley. *With a map. Journal of the Asiatic Society,* 1835.

(Continued from page 164.*)*

Our author having left Oogah passes a few sandstone rocks, and also an island resembling the "knot in appearance and structure, and arrives at the foot of Jeeka." The elevation of Jeeka is represented at 3,000 feet; it rises in an abrupt manner above the range with which it is connected, and has the appearance at a distance of an isolated hill. A dense forest with a little variety of shade covers the mountain from top to bottom. This is a singular feature in the character of the hills in Arracan. At Sandoway we have ascended immense heights where we have found splendid forest trees; it shews how fertile the soil is, and that these mountains may be cultivated to their summits. The height, of which Lieut. Foley is speaking, is level and clear, but uncultivated; the inhabitants will not fix their habitation there on account of wild beasts with which it abounds. The deluded people are likewise possessed with the belief that fairies and evil spirits would be equally troublesome and frequent intruders. Our author observed the prints of elephants' and tigers' feet in several places. Herds of elephants may be frequently seen during the evening feeding upon the long grass and underwood at the foot of the mountain. The inhabitants do not attempt to catch or destroy them, although they are particularly troublesome in the months of October and November, (when the rice crops are ripe) when they descend into the plains committing much mischief. With respect to the geological feature of Jeeka, a brown ferruginous sandstone regularly stratified, with an inclination to the south-west, was the only rock visible on the surface. Lieut Foley did not ascertain whether this sandstone appeared on the summit of the mountain or was succeeded by some other rock. Stratification is distinct at the foot of a small range bounded by the sea at a little distance beyond the mountain. The several layers rising from under each other for a considerable extent resemble a sandstone which covers the lignite coal of Phooringooé, an island to the east of Combermere bay. Our author proceeds eastward; the road was over hills intersected with ravines and covered with jungle, the road leads to *Rambreengheh, Kyouk-nemo, and Singhunnethe.* Our author saw the flying squirrel on this occasion.

"It is a very handsome creature, and larger than the squirrel of Europe. The head, back, and tail are covered with a rich coat of dark-brown fur; the under part of the chin, neck, belly, and legs being of a bright yellow colour. The skin about the sides and forelegs is loose, and capable of being so much extended, that in making its prodigious spring from tree to tree it appears rather to fly than leap. It is said to be very destructive to gardens; if taken young it may be rendered perfectly tame."

The village *Rambreengheh* is large and remarkably neat, surrounded by hills and gardens of plantain trees. The soil is of a rich yellow clay, on which are seen indigo, tobacco, and pepper plants. To the right and beyond this spot is the village *Kyouk-nemo*, accessible to the sea and once infested with dacoits. Lieut. Foley reaches a creek which he crosses. The shore on the opposite side consists of deep clay. Our author proceeds to the village of *Singhunnethe.*

"*Singhunnethe*, as was the case with all the villages that I had seen on the southern side of the island, is surrounded with plantain trees, which not only afford a wholesome and favourite article of food, but are in constant request for the production of a solution of potash* used in the preparation of dyes, more especially in those derived from indigo. The mode in which the potash is obtained from the plantain trees is similar to that followed in other parts of the world in its extraction from the

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* During the time that Government held the monopoly of salt in Arracan, the plantain trees frequently afforded to the poor a substitute for the common sea salt. So strictly were the Government rights protected, that a poor woman was actually prosecuted in one of the courts for collecting a little sea salt off a rock on which it had been deposited on the evaporation of the water left by the tide!

different vegetable substances that produce it, with this exception, that it is held in solution by the water, which is not suffered to evaporate. The stem and branches of the plantain tree are divested of the outer rind, and then broken up into small pieces, which are laid upon the fire and slowly consumed; the ashes are lixiviated with water which is strained off, and reserved for mixture with the dyes. In front of the *Soogree's* house, and in the centre of the village, a nice tank had been dug; the only one I had hitherto met with, tanks being seldom seen except in the neighbourhood of large towns. The houses were neat and built with more attention to comfort and order than is general in the villages of *Rambree*. I remarked a hideous representation of the human countenance drawn with lime upon several of the door-posts. I was told, it is put up to deter the *demon of sickness* from entering the dwelling. Much sickness had been experienced of late, and this was one of the many absurd customs resorted to, with the view of ridding the neighbourhood of its presence. I further learned that when any one of a family has been a long time sick, and recovery appears doubtful, the inmates of the house assemble and make a tremendous noise with drums and gongs, at the same time beating the roof and walls with sticks to expel the evil spirit who is supposed to have taken possession of the dwelling. One door alone is left open for his escape, all the others being closed. While this is going on a *Phoongree* stands upon the road, opposite to the house, reading a portion of the *Khubbowah*, a book that is held in particular veneration. A further ceremony is sometimes observed by the invalid as an additional security for a complete restoration to health; but it is only performed by those who feel themselves, as it is termed, *possessed*, and called to the exercise of the duty required of them, as a propitiatory sacrifice to the malignant spirit from whose ill will their sickness is supposed to originate. This ceremony, which is called *Nâth-Kadèy*, very much reminds me of the antics played by the dancing Dervises of old. A brass dish, or any piece of metal highly burnished, is put up in a frame, and in front of this are laid offerings of fruit, flowers, and sweetmeats. When every thing has been properly arranged, the invalid commences dancing, throwing the body into the most ludicrous attitudes; and pretending to see the object of worship reflected upon the plate of metal, makes still greater exertions, until the limbs are overpowered, and the dancer sinks exhausted upon the ground. Should the sick person be so weak as to render such assistance necessary, he (or she,) is supported by a friend placed on each side during the whole of the ceremony. It is by no means improbable that this violent exertion has on many occasions proved highly beneficial, realizing the most sanguine expectations of the people. In cases of ague or rheumatism, where a profuse perspiration, and a more general circulation of the blood throughout the human frame is required, there is perhaps no other mode of treatment more likely to produce the desired effect; and could some proper substitute be found for a piece of metal, the *Nâth-Kadèy*, might be introduced with advantage into our own hospitals."

The following observations may give subject for discussion which now divides the fluvialists and diluvialists in England and France. Talking of the Mughs, Lieut. Foley adds—

"It is their belief that there are many worlds, and that the earth has been subject to the several and repeated actions of fire and water. (A fact that will not perhaps be disputed by some of the most celebrated geologists of the present day.) The soul, they affirm, may pass through many stages of existence, either in this or another world; the nature of each change depending upon its moral condition."

Our author proceeded over a red hill covered with a red iron clay.

"From the summit of this hill I enjoyed a fine prospect of the channel that divides the eastern side of the island from the district of Sandoway. The hills of *Lamoo* and *Kalynedong* rose on the opposite shore, and the distant mountains of *Yoomadong* were faintly visible amidst the clouds that surrounded them. Descending this range I approached the village of *Saain-kyong*, celebrated for its lime. The limestone is found at the foot of a high hill to the left of the road. This was the first limestone that I had seen on Rambree Island; and it is so concealed by the jungle, that had I not been previously made aware of its existence and enquired for its site, I should have proceeded on my journey unconscious that such a rock was in my neighbourhood. From its appearance, and more particularly from the rocks with which it is associated, I am inclined to class it with the "*upper fresh-water limestone*" found in tertiary formations; it is of a greyish white-colour; of a fine compact texture, but very brittle. It occurs in several detached masses of a globular or columnar form, and although I made every possible search along the ravines in its neighbourhood, I could discover nothing that would indicate the slightest approach to a stratification; nor has this species of limestone been discovered in any other part of the island. There were no appearance of the fossil remains sometimes found in this rock, such as fresh-water shells, &c. The limestone is split into several large fragments by means of fire; these are again broken into smaller pieces, and the whole conveyed in baskets to the lime-kilns constructed on the banks of the *Saayre-kyong* creek, which at full tide has sufficient depth of water to admit of the approach of large boats. The whole of the lime used in *Rambree* Island, either for architectural purposes, or for the preparation of the edible chunam, is obtained from this rock. I was told that the lime, if taken in large quantities, was sold on the spot for 3½ maunds per rupee, and that there were generally from 100 to 200 maunds collected. Crossing the creek at low water, I

observed a few boulders of lias clay and calc spar imbedded in its banks. Proceeding from thence by a neat *Kioum* and grove of mangoe trees, I arrived at *Seppo-towng*, a village situated at the foot of a high hill covered with forest trees, and diversified with a few spots of ground cleared for the cultivation of the plantain tree. The tall *Girjuns*, with their white trunks divested of branches, were eminently conspicuous amidst their more graceful but probably less serviceable neighbours. The *Girjun* yields the oil that bears its name, and is used for combustion as well as for admixture with paints, varnishes, &c. (See Jour. As. Soc. II. 93.)

These trees are very abundant upon the island, and are farmed by Government. The mode of extracting the oil would appear to be as follows: a deep notch is cut in the trunk of the tree by means of a *dhao* or other instrument, and to this fire is applied until the wood becomes heated, and oil is seen to exude upon the surface. In the course of three or four days perhaps as much as a seer or a seer and a half of oil is collected within the cavity, and the tree will continue to afford a certain quantity of oil for five months or more, the collections being generally made every fifth day. When the oil has ceased to flow the tree is again cut in the same place, so that the whole of the wood which had been consumed or scorched is removed; fire is once more applied, and the oil collected as before. The notch has after repeated cuttings become so deep as would render any further attack upon the trunk, in this particular spot, destructive to the tree; in which case the *dhao* is laid upon another part of the trunk, and the same process observed as before mentioned. The tree is said to yield oil at all seasons of the year, precautions being taken during the rains to exclude the water. A large *Girjun* tree has been known to produce oil for 12 successive years, and as others are constantly supplying the place of those destroyed, there is no falling off in the amount of the several years' collections. The oil is sold in *Rambree* at the rate of two or three maunds per rupee, and the greater part of it bought for exportation."

In our next we shall conclude this interesting account of *Rambree.*

Art. IV.—Madras Journal of Literature and Science, published under the auspices of the Madras Literary Society and Auxiliary Royal Society, edited by the Secretary to the Asiatic Department, No. 12, *July,* 1836. *Oct. pp.* 240. *Madras. Printed and Published by* J. B. Pharoah.

The light of science and literature is now bursting forth in all parts of India! When we commenced the labours of our new work we did not expect to have upon our desk so many splendid productions, containing, in so great a measure, erudition and talent; but they crowd upon us, and no sooner is one passed through analysis than another is submitted. The work we are now about to examine has just reached us but in time to enable us to announce it to our readers. A brief examination of its contents has been quite sufficient to prove that the journal contains matter which will excite intense interest among the scientific circles of the east, as well as add considerably to our present state of the physical and geological character of India. The geological papers are from the well known pen of Dr. Benza and Mr. Robt. Cole. The former gives a geological description of the country between Madras and Neilgherry hills; the latter on the geological position and association of the laterite in iron-clay formation of India, with a description of that rock as it is found at the red hills near Madras. An exceedingly interesting communicati on of Col. Monteith's on a visit to Cumbaucumdroog—a remarkable table land near Madras, contains some reference to the geological character in that direction. On botanical subjects are observations on the Flora of Courtallum, by Dr. R. Wright, and Remarks on the Vegetation of the Neilgherries, by Captain Allardyce. There are notes also by Col. Monteith on Persia, Tartary, and Afghanistan. A paper of great value by Mr. Taylor, astronomer to the H. C. C. gives a cursory view of the present state of astronomical science, with a summary desiderate, together with a notice of astronomical results at the Madras observatory. We also observe a communication on the mass of the planet Jupiter, by Goday Venkata Juggarow. In addition to the foregoing we find a curious and able paper on the metamorphosis of the musquito, by Mr. Gilchrist. Among literary and historical subjects is a paper giving a brief notice of some of the Persian poets, by Lieut. Newbold; a communication on the genealogy of the Kings of the Mahomedan dynasty in Achin, by Lieut. Reynolds; also observations on original and derived languages, by the Rev. B. Schmid. We promise however to give our readers an analysis of these articles in our next and succeeding numbers.

Art. V.—First part of the twentieth volume of Asiatic Researches or Transactions of the Society instituted in Bengal for enquiring into the History, the Antiquities, the Arts and Sciences, and Literature of Asia. Quarto: pp. 243, 1836. *Calcutta, Printed at the Bengal Military Orphan Press*, G. H. Huttman.

The above work has just been published: it opens with a translation of various incriptions found among the ruins of Vijayanagar, communicated by E. C. Ravenshaw, Esq. Bengal Civil Service, with preliminary observations, by H. H. Wilson, Esq. late Secretary Asiatic Society. The second article is an analysis of the Dulva, a portion of the Tibetan work, entitled the Kah-Gyan, by A. Csoma de Körös. Mr. Hodgson, the British resident of Nipal, has furnished an article on the administration of justice in Nipal, with some account of the several courts, extent of their jurisdiction, and mode of procedure.

A very curious but learned essay on Sanscrit Alliteration is given by that eminent Sanscrit scholar, the Rev. W. Yates. Lieut. Colonel Burney has communicated additional proof of his zeal in oriental literature by his article on the Translation of an inscription in the Burmese language discovered at Buddha Gaya, in 1833. One of the most valuable papers in this number of the Transactions is on the Results of an enquiry respecting the law of mortality for British India, deduced from the reports and appendices of the committee appointed by the Bengal Government in 1834, to consider the expediency of a Government Life Assurance Institution, by Captain H. B. Henderson, Assistant Military Auditor General and Secretary to the Committee. We shall consider this article fully in our next, and also give our readers an insight into the other communications to which we have alluded, as we find space.

Art.—VI. Cursory notes on the Isle of France, by E. Stirling, Esq. member, Asiatic Society, Calcutta. Vol. pp. 50. *Messrs.* Thacker & Co.

Many of our Indian invalids proceed to this isle. Intelligence concerning a geographical and statistical description, its manufactures, public works, public buildings, civil and military laws, tribunals, police, religion, churches, its commerce, &c. all of which subjects this work treats, cannot fail to be interesting to our readers. We shall notice particulars fully hereafter.

GENERAL SCIENCE.

PROCEEDINGS OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

This fine Natural Institution continues to prosper far beyond anticipation. The Fifth Annual Meeting, which commenced at Dublin on the 10th and terminated on the 15th of August, as much surpassed the Edinburgh meeting, both in the interest of the proceedings and in the numbers of individuals who flocked to take a share in the daily business, as the latter meeting exceeded that which preceded it. It is pleasing to be able to prove this assertion, by a statement of facts: The receipts in Edinburgh were £1, 626, while those in Dublin were £1,750. The number of subscribers in Edinburgh was little above a thousand: in Dublin, it amounted to 1,228; and, it is quite certain that it would have been much greater, if it had not been that the arrangements of the Local Committee were either not generally known, or not attended to in time by many residents, whose applications could not be received after the commencement of business, in consequence of the great influx of strangers.*

* It is easy to complain and find fault, but while we approve highly of the general arrangements of the Dublin local committee, we cannot refrain from submitting for the consideration of the Bristol committee, the importance of adopting a method of giving out Tickets and receiving subscriptions, which shall dispense with the crowding, and fighting we might almost term it, which is unavoidable by the mode at present pursued, and which seems to paralyze those engaged in the troublesome task. It would be proper also that persons should be employed in these preliminary arrangements, who are acquainted with the names of those engaged in prosecuting science. It is ridiculous to hear such a question as, "*Have you written any papers?*" addressed to men holding the highest place in science.

That the capital of Ireland was chosen as the place of convention for the meeting of this year, we know was hailed by our hospitable neighbours with those feelings which we should have expected from the countrymen of such scientific lights as Robert Boyle, Kirwan, and Brinkley. But that the reception given to the Members of the British Association could have been equal to what each individual member found it to be, we are confident none could have most distantly anticipated. If respect to the delicate feelings of our open-hearted friends did not forbid every one who shared in the kindness which was so liberally exhibited, to remove that thin veil which ought always to prevent private hospitalities from being held up to public gaze; how could not each of the twelve hundred and twenty-eight members of the British Association depict innumerable instances of traits of character, of friendly actions, and of soundness of principle which could not be exceeded, go where he might: and must ever be viewed by the philanthrophist, as most honourable to human nature. The present meeting has demonstrated that Science is not asleep in Ireland, but that it is quietly and modestly cultivated, and is ready to burst forth whenever due encouragement is administered to fan its kindling embers. That the causes of dissension which have so long prevailed in the green island may speedily be dissipated, and that the United kingdom and the Sister island may in future aspire only to increase each other's prosperity and greatness, was the public expression of some of the most distinguished leaders, and was ardently responded to by every member of the Association. Let us hope that Science, which is not sectarian in its nature, which is of no country, or climate, but which is universal as the principle of gravity, may tend to heal all chafing wounds, and serve to unite in the bonds of friendship, all those who are engaged in investigating her hidden stores, the wonders of creation.

On Monday the 10th of August tickets of admission were procured by strangers; those of residents having previously been obtained as required by a public announcement.

In addition to most of the British men of science, several foreigners joined the lists of the Association. Among these were M. Agassiz, of Neuchatel, and Dr. Moll, of Utrecht, who were also present at Edinburgh.

At 10 A.M. the different Committees of the Sections began to meet.

The Sections were as formerly, six in number.

A. Mathematics and Physics.

Subsection A. Mechanical Arts. This subdivision was formed in consequence of the press of matter in the department of General Physics.

B. Chemistry and Mineralogy.

C. Geology and Geography.

D. Zoology and Botany.

E. Anatomy and Medicine.

F. Statistics.

GEOLOGY AND GEOGRAPHY.

*Monday, 10th August.**

President, Mr. Griffith. Vice-Presidents, Mr. Murchison; Professor Sedgwick. Secretaries, Captain Portlock; Mr. Torrie.

1. The Chairman exhibited a Geological Map of Ireland, the construction of which had occupied his attention for many years; and, although there might be some errors in matters of detail, he believed that it was generally correct, and afforded a faithful outline of the physical structure of Ireland.

One remarkable peculiarity in the physical structure of Ireland is, that while the waters are almost every where fringed with ranges of primary mountains, the interior of the country is level, or slightly undulated, and hence the course of most of the Irish rivers; in fact, the Shannon affording the only exception to this remark.

Another remarkable circumstance in the physical history of Ireland, is the frequent occurrence of long ranges of granite hills, often attaining the height of twenty or thirty miles, and running parallel to each other. In ancient times roads were constructed on the tops of these natural mounds. The usual course of these ridges is E. & W., but occasionally they are N. & S.

These heaps of granite give an undulatory aspect to the country; and, it is to this circumstance that the profusion of ridges in Ireland is owing; the depressions between the ridges becoming receptacles for water, and being afterwards obliterated by the formation of peat, the result of the decay of aquatic plants.

It is, of course, beneath this accumulation of peat, and in the subjacent marl that the remains of the Irish elk are found. This marl is, in part at least, produced by the granite previously described, and sometimes attains a thickness of forty feet.

The speaker then proceeded to consider the stratified rocks; first describing the primary tracts which occur towards the coast, and then the vast and level district of calcareous rocks which occupies almost the whole of the

A great error committed in Dublin was, in having the gardens attached to the Rotunda, open during the evening meetings. One of the most curious and interesting Lectures delivered during the week, viz. that of Mr. Wheatstone, on Saturday, was not heard by the greater proportion assembled in the room, in consequence of interruption from persons going to the gardens and returning to the room.

* To Professor Powell of Oxford, and Dr. Scouler of Dublin, the Editor is almost solely indebted for the reports of the proceedings of the Geological and Physical Sections. He is himself responsible for the details relating to that of Chemistry; and for the other reports he is obliged to Mr. King of Dublin and to other sources.

interior of the island. The elevation of the strata throughout Ireland is remarkably uniform, being N. E. and S. W. in almost every part of the island; to this remark, however, there are some exceptions, as, in the county of Tyrone, where the elevation of the strata is from N. to S.

From what has been stated, it is obvious that the primary rocks generally occur near the coast, constituting the mountainous regions of Down, Donegal, Mayo, Galway, and Wicklow, &c. These regions containing all the usual primary masses; as gneiss, mica-slate, clay-slate, and quartz rock, present in each locality many interesting appearances, which we have not sufficient leisure to detail.

Quartz rock, however, occurs at Dunmore Head, under some interesting modifications. It contains abundance of globular concentric concretions, differing, in no respect, in their structure from the fibrous masses found in trap, and, like them, decomposing in crusts.

In Donegal, beds of primary limestone occur, often alternated with mica slate, and have, in many cases, been changed into dolomite.

Mr. G. then remarked that his information concerning the transition formations was less complete. These rocks consist of the greywacke and old red sandstone formations. In Cove of Cork both these are schists containing fossils.

These transition and schistose rocks are succeeded by the mountain limestone, which occupies about two-thirds of the whole surface of Ireland. The organic remains found in these calcareous rocks are, in general, the same as those found in England.

This limestome is succeeded by the coal formation. The newer secondary strata only occur in the north of Ireland, where we have the new red sandstone, with gypsum and beds of magnesian limestone, and these rocks are succeeded by lias, oolite, and chalk.

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2. Dr. WEST AFTERWARDS READ AN ABLE PAPER ON THE GEOGRAPHY OF SOUTH GREENLAND.

Tuesday, 11th August.

3. THE REV. ARCHDEACON VERSCHOYLE READ AN INTERESTING PAPER ON A SERIES OF TRAP DYKES WHICH OCCUR IN THE COUNTIES OF MAYO AND SLIGO.

These dykes are remarkable for the length and distinctness of their course. Their elevation is E. & W. They are, consequently, parallel to each other, and one of them has been traced for a distance of forty-five miles. These dykes, during this long course, intersect a great variety of rocks, as slate, sand-stone, limestone, mica, and slate, &c., and here produced many curious changes, converting the sandstone into quartz, and even giving it a columnar form. It was the opinion of the Reverend gentleman, that these veins, or a series of them, extended across the island. Mr. Griffith here remarked, that between Dundrum and Dundalk, on the opposite side of the island, a great number of trap veins had been observed.

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4. PROFESSOR JOHN PHILLIPS NEXT READ A PAPER ON THE FOSSIL ASTACIDÆ.

The speaker commenced by making some remarks on the natural history of the genus Astacus. Of the species which compose the genus Astacus, as at present existing, some are found in salt and others in fresh water. There are two empiric characters by which the marine may be distinguished from the fluveatile Astaci: In the marine species the lateral divisions of the tail are transversely divided, while in the fresh water species the division is longitudinal. The marine species have also large didactylous claws to the first pair of feet.

All the fossil species possess those characters which belong to the marine division. Proceeding to investigate the question as to the possibility of identifying strata by means of their organic remains, it was remarked that the study of the fossil species of the present genus did not afford results very favourable to such a hypothesis. Confining our attention to the oolite and lias, it was observed that one species of Astacus was found in every bed, from the lowest of the lias to the uppermost of the oolite.

One species was confined to the coral rag; four species were peculiar to the green sand; some of the species were more local, and others appear to have had a wider geographical distribution, as is the case with the Astaci of the present day.

MR. GRIFFITH THEN RESUMED THE EXPLANATION OF HIS GEOLOGICAL MAP, AND DESCRIBED THE ERUPTED ROCKS WHICH HAVE BEEN OBSERVED IN IRELAND.

He divided the unstratified masses into three portions: 1. Those occurring in transition and primary rocks: 2. In the older secondary: 3. In the newer secondary.

It was remarked that the limestone which comes in contact with the erupted rocks of the primary division, is often changed into dolomite.

Green stones occur among the older secondary rocks in the county of Limerick. These green stone beds are apparently interstratified with the lime-stone, but fragments of this latter rock are included in the trap.

The trap veins occurring in the newer secondary formations, as in the chalk of Antrim, are already sufficiently well known. Mr. G. is of opinion that the porphyry of Sandy rock is merely a modification of the ochre beds which are observed at the Giant's Causeway, as there is a striking resemblance between the two rocks, in point of mineral character, and both contain nodules of mesotype.

Wednesday, 12th August.

MR. GRIFFITH GAVE AN ACCOUNT OF A MASS OF SHELLY GRAVEL IN THE COUNTY OF WEXFORD: THIS DEPOSITION IS VERY EXTENSIVE, STRETCHING ALONG THE COAST FOR A DISTANCE OF SEVENTY MILES, AND ATTAINING A BREADTH OF EIGHTEEN. THE FOLLOWING IS A SECTION OF THIS DEPOSIT:

5 feet of clay
7 feet marl clay
7 feet marl
7 feet of sand
11 feet of gravel, containing abundance of marine shells.

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5. MR. PHILLIPS THEN READ A PAPER ON THE GENUS BELEMNITE.

He observed that such was the progress which the study of organic remains had made, that no less than one hundred species were now known to naturalists; and of these, about thirty-four species had been found in England.

Shells of this genus are confined to the chalk, oolite, and lias, and the results which their study affords, contrast remarkably with the negative indications deduced from an examination of the fossil Astaci. One division characterized by a little swelling at the apex, and possessing a lateral fissure, was confined to the chalk. The species which were obtusely mucronate are found in the green sand. The species with a groove in the back are found in the middle oolite: Those with a lateral groove, in the lias, and lower oolite; and those species which are destitute of a groove are confined to the lias. From these remarks, it appears that not only are the species of Belemnite confined to certain strata, but that even certain natural divisions of the genus are found together in the same beds, and in no others. Another curious remark is, that species which are common in the chalk of the Continent, are rare in the chalk of England, and vice versa.

These remarks were followed up in an admirable manner by M. Agassiz, who, from a study of the remains of this difficult genus, clearly demonstrated that the shell was an interior one, analogous to the bone of the cuttle fish, and not an exterior shell, as is generally imagined.

Thursday, 13th August.

7. M. AGASSIZ LAID BEFORE THE ASSOCIATION AN ADDITIONAL NUMBER OF HIS WORK ON FOSSIL FISHES;

And, in an eloquent address, he gave a summary of the geographical conclusions to which the study of fossil fishes had conducted him; and expressed his conviction that strata might, in all cases, be identified by means of the remains of fishes; or, in other words, that each geological epoch was characterized by its peculiar and exclusively appropriate race of fishes.

During this part of the proceedings Mr. Sedgwick took the opportunity of putting M. Agassiz's knowledge to a severe test. He exhibited a specimen containing impressions of fossil fishes, and M. Agassiz, after explaining the zoological characters which distinguish the fishes of different geological epochs, at once declared the specimens before him had been derived from the new red sandstone.

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8. Dr. TRAIL THEN READ A PAPER ON THE GEOLOGY OF SPAIN. HE CONFINED HIS REMARKS CHIEFLY TO THE PROVINCE OF ANDALUSIA.

In this interesting country we have every variety of rock, from the oldest primary, up to the tertiary strata. The mica slate of Andalusia contains many interesting minerals, as iron, glance, and lead ore. This last mineral is so abundant that no less than 35,600 tons were extracted in one year. The primary rocks are succeeded by secondary sandstones, in whose fissures interesting osseous remains occur. These lime-stones extend to the opposite coasts of Africa. This limestone is followed by new red sand-stone, and gypsum marl, abounding in salt and saline springs. Oolite rocks occur near the ancient town of Cartua; and chalk, with flints, is observed at Labriga. Tertiary and fresh water lime-stones also occur, as has been noticed by Colonel Silvertop.

The beds at Valencias vary from 6 to 8 feet in thickness, and repose on marl and gypsum.

Friday, 14th August.

9. MR. PHILLIPS GAVE AN ACCOUNT OF A SMALL PORTION OF A TERTIARY FORMATION WHICH HAD BEEN OBSERVED IN YORKSHIRE.

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10. MESSRS. MURCHISON AND SEDGWICK THEN GAVE AN ACCOUNT OF THE ROCKS ANTERIOR TO THE COAL, AND POSTERIOR TO THE PRIMARY STRATA.

These rocks, which were formerly distinguished by the absurd term of transition strata, have been, unaccountably much neglected by geologists; and, unfortunately, the use of this term has given rise to much confusion in geological writings. Mr. Murchison has, for several years, devoted his time to the study of the older secondary rocks, as they occur in Wales, while Mr. Sedgwick has investigated those of Cumberland.

According to Mr. Murchison, the older secondary rocks of Wales, which he, for the sake of convenience, denominates the Silurian group, may be classed under three divisions, each of them containing its peculiar organic remains, and consisting of a great variety of rocks.

In the descending series, and departing from the old red sand-stone, we have the Ludlow rocks, attaining to a thickness of 2,000 feet, consisting of crystalline argillaceous lime-stones, with flags and shales.

These rocks are followed by the Wenlock group, consisting also of limestones and shales. These are succeeded by what Mr. Murchison has denominated the Caradoc

group, a series of rocks similar to the preceding, and attaining to a very great thickness.

These formations, however, appear to be newer than the Cumbrian rocks which have been investigated by Mr. Sedgwick, and which he also divides into three subordinate groups, all of which are included under the name of Cumbrian rocks. The first, or upper, is the Plinlimmon group: the second, or Snowden group; and, thirdly, a lower group. The details on this last series of rocks were rather meagre, but we have no doubt that ample information will shortly be laid before the public.

CHEMISTRY AND MINERALOGY.

Monday, 10th August.

Dr. Thomas Thomson, President. Dr. Dalton, and Dr. Barker, Vice-Presidents. Dr. Apjohn, and Mr. Johnston, Secretaries. *Committee*,—Mr. Davy, Mr. Vernon Harcourt, Dr. Daubeny, Mr. Graham, Mr. Connell, Dr. R. D. Thomson, Mr. Kane, Mr. Ferguson, Mr. Scanlan, Dr. Geoghegan, &c.

The Secretary presented to the Section printed copies of tables, exhibiting at a single view, the most important properties of simple and compound bodies, for defraying the expenses of the printing of which, £10 had been allocated at the last Meeting of the Association.

1. A PAPER WAS THEN READ BY MR. DAVY, UPON THE SUBJECT OF THE CORROSION OF IRON BY SEA WATER.

The observations had particular reference to the injury sustained by the iron of buoys, subject to the influence of sea water in harbours, as at Kingstown; where it has been recently found, that the rings upon which the safety and utility of the buoys mainly depend, rapidly corrode and are destroyed. Mr. Davy turned his attention to the important object of providing a remedy, and preventing the corrosion of the iron; and although his experiments had only recently been commenced, still he considered it proper, to bring the few results he had procured before the Section, for the purpose of exciting further inquiry. He found that zinc applied to iron prevented corrosion. Rings of this metal were cast into forelocks for the purpose of experiment, and were found to obviate the waste to which the iron had previously been subject.

According to Sir Humphry Davy, the cause of the corrosion of copper, and metals in contact with sea water, is attributable to the access of atmospheric air. He considered that if the air was preserved from coming in contact with the metal, no decomposition would ensue. Mr. Davy accordingly found, that copper exposed to the action of sea water free from the influence of air, was not liable to corrosion, and that the effect was influenced by the depth of water. Specimens of metals were exhibited, which had been subjected to the influence of salt water free from air, and no corrosion had taken place; other pieces of metal which were in contact with sea water subject to the influence of air, were observed to be much injured. Mr. Davy attributed the cause of the phenomenon to an electrical decomposition.

He stated further, that he had found zinc to preserve tin plate, both in fresh and salt water.

Some observations were made by members of the Section, with regard to the action of sea water upon bar and cast iron. Some attributed the greatest corrosion to the former, others to the latter.

2. MR. ETTRICK DESCRIBED AN IMPROVEMENT WHICH HE HAD MADE UPON DAVY'S SAFETY LAMP, FOR THE PURPOSE OF OBVIATING ACCIDENTS WHICH ARE ENTIRELY OWING TO THE CARELESSNESS OF WORKMEN.

The Davy lamp, he stated, to be perfect in principle. The workmen are in the habit of enlarging the apertures in the wire gauze, and applying their tobacco pipes in order to obtain a light. The modifications recommended at present, were the introduction of very strong glass, to cover the gauze externally. The glass is again guarded by strong ribs of iron, so that the lamp may be exposed to considerable shocks without danger of injury. A contrivance was also described by which the air was allowed to enter from below, by means of a gauze tube, but so managed, that the gauze could not be reached by the workmen.

Various improvements upon the Davy lamp were noticed by different members.

Mr. Graham stated, that he had been paying considerable attention to the subject, and had found that when the gauze was steeped in an alkaline solution, the flame was prevented from passing so readily, and corrosion was obviated.* He considered the only adequate provision against accident to be the employment of a double gauze cover.

3. MR. KANE READ A COMMUNICATION IN REFERENCE TO PYROXYLIC SPIRIT.

The experiments which he had made upon this substance, corroborate the opinion of its composition entertained by Dumas and Pelligot, who term it methylene, viz. that it is a compound of an atom of carbydrogen, and 1 atom water, having for its atomic weight 2. He had examined the action of sulphuric acid upon the liquid, and had obtained by distillation, an acid capable of forming salts with bases. The composition of several of these, he had ascertained by determining the proportions of the acid, (or sulpho-

* This is agreeable to the results obtained by Dr. Thomas Thomson many years ago.

methylic acid) and base, and considering the loss to be methylene. The compound with lime, consisted of 1 atom lime + 2 atoms sulphuric acid + 1 methylene.

Some discussion took place in reference to the double atoms, of which the organic bases are stated to consist, according to the views of Continental chemists. Considerable misunderstanding was exhibited in many of the observations offered upon this point. But it is unnecessary to repeat the statement of the various theories, as this has been already done in the previous number of this journal.

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4. Mr. FOX DESCRIBED AN EXPERIMENT WHICH HE HAD MADE, WITH REGARD TO THE EFFECT OF MELTED IRON UPON THE MAGNET.

He found that no action was exerted upon it. Hence, this is an argument against the idea of a central fire.

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5. A LETTER WAS READ FROM Dr. TURNER, REPORTING THE OPINION OF THE COMMITTEE APPOINTED AT LAST MEETING, TO TAKE INTO CONSIDERATION THE ADOPTION OF A UNIFORM SET OF CHEMICAL SYMBOLS FOR THIS COUNTRY.

The opinion of the majority was, that those used on the continent should be had recourse to. It was strongly recommended that the abbreviations should not be carried further than the dots for oxygen; indeed, it was suggested by some, that these should be rejected, as they merely express theory, and consequently vary, according to the view that is taken of the composition in this country and on the continent; but it is obvious, that if brevity is not carried any further than this, no bad consequences can follow from a system of notation.

Dr. Thomas Thomson strongly recommended that the centigrade thermometer should be adopted in this country for scientific purposes, as being infinitely better adapted for such purposes than that of Fahrenheit. His suggestion appeared to coincide exactly with the opinion of the committee.

Tuesday, 11*th August*.

6. Mr. DAVY DETAILED SOME EXPERIMENTS WHICH HE HAD MADE UPON THE PRESERVATION OF TIN PLATE BY THE AGENCY OF ZINC.

When exposed for some days to the action of water, the plate by itself soon becomes slightly corroded, but is completely preserved by the zinc, the latter, at the same time, oxidizing. Hence, the plate might be employed in place of copper for many purposes, where salt water comes in contact with vessels. Several metals he had ascertained are not protected.

7. MR. GRAHAM DESCRIBED THE CONSTITUTION OF CERTAIN SALTS IN CONTINUATION OF THE PAPERS WHICH HE HAS PUBLISHED UPON THIS SUBJECT.

He views sulphuric acid as a sulphate of water, and as represented by H S. Sulphuric acid of spec. grav. 1·78 is hydrous sulphate of water, or a hydrate expressed by H S H, 1 atom being basic and essential to the composition of the acid, the other being driven off by heat. Hydrated oxalic acid is an oxalate of water H (C + C) H2.

Nitric acid = H N H^3 of spec. grav. 1·42.
Oxalate of magnesia = Mg (C + C) H^2.
Nitrate of copper = Cu N. H^3
There are three oxalates of potash,
1. K (C + C) H.
2. K (C + C) H (C + C) H^2, or binoxalate; decomposes at 300° and loses 2 atoms.
3. K (C + C) H $\left\{\begin{array}{l}\text{H (C + C) H}^2\\ \text{H (C + C) H}^2\end{array}\right.$ or quadroxatate, the 2 atoms of water in the binoxalate being replaced by hydrated oxalic acid.

There are two remarkable salts, which correspond with each other in composition, viz., oxalate of potash and iron which is green, although the iron is in the state of peroxide, being precipitated red by potash, and the oxalate of potash and chromium which is dark coloured. The first is represented by Fe $(C + C)^3$ 3 K (C + C) + H^6.

If we substitute chromium for iron, we have the composition of the chromium salt.

The same law in reference to water, it is probable, is generally applicable to the composition of the carbonates. Carbonate of magnesia is represented by Mg. CH^2. At 212° the water is expelled.

Bicarbonate of potash = K C H C is a carbonate of potash and a carbonate of water, because the latter can be readily driven off. Two additional atoms of water may exist in it. The bicarbonate of potash and magnesia of Berzelius, has the same composition as quadroxalate of potash, the symbol being K C H C $\left\{\begin{array}{l}\text{Mg. C H}^2\\ \text{Mg. C H}^2\end{array}\right\}$ + H^4 making 9 atoms of water in the salt, and the magnesia occupying the place of the water in the quadroxalate of potash.

Rose described a class of salts formed by the absorption of dry ammonia. He considered the ammonia not to act as a base, but to take the place of water.

Mr. Graham coincides with him in opinion. The composition of ammonia may be represented by N H^3 N H^3 H O, being analogous to sulphuric ether, which consists of 2 atoms olefiant gas. The nature of its function may be observed in the composition of the common sulphate of copper and ammoniacal copper, the first is Cu S H + H^4, the second Cu S H + $(N\cdot H^3)^4$ the ammonia taking the place of the water. There are 2 ammoniurets, 1 containing 4 and the other 5 atoms of water.

8. MR. JOHNSTON MADE SOME OBSERVATIONS ON THE OPTICAL PROPERTIES OF CHABASITE, IN REFERENCE TO THOSE MADE BY SIR DAVID BREWSTER AT LAST MEETING.

Sir David found that this mineral possesses different refracting powers at different depths of the crystal, and he concluded, that it consisted of distinct layers, and that if subjected to experiment it would afford the result of a compound substance. His results refer to particular species only; but the composition of the species vary, and are as represented here

$$\left.\begin{matrix} C \\ N \\ K \end{matrix}\right\} \begin{matrix} S^2 \\ S^3 \end{matrix} + 3\,A\,S^2 + 6\,Aq.$$

where Mr. J. conceives that it is easy to see the cause of the difference, for the refractive power of chabasite is positive, and that of quartz negative; thus accounting for the double refracting power observed by Brewster.

Dr. Thomson remarked that the observations of Brewster probably referred to one species of chabasite. But there are two species, the one containing soda and the other lime as a base. He, therefore, considered that until both species were examined, no inference whatever could be drawn.

9. DR. DAUBENY STATED, THAT ACCORDING TO THE OPINION OF VON BUCH, CARBONATE OF MAGNESIA MUST HAVE BEEN SUBLIMED IN MANY INSTANCES BY VOLCANIC ACTION, ALTHOUGH AS FAR AS DR. DAUBENY WAS AWARE, IT WAS NOT AGREEABLE TO THE RESULTS OF CHEMISTS.

A curious fact illustrative of the truth of Von Buch's opinion, occurred to Dr. Daubeny in Italy. He visited a locality where there was an upper stratum of lava, containing cavities. In one of these Colonel Robinson discovered a large quantity of carbonate of magnesia. Dr. Daubeny found a quantity coating the upper surface of the lava.

Dr. Dalton observed that there could be no doubt as to the sublimation of carbonate of magnesia, as Dr. Henry had informed him that a quantity of this salt was always driven off whenever the heat was carried beyond a certain height.

10. DR. DALTON STATED THE RESULTS OF HIS EXAMINATION OF THE SPIRIT DISTILLED FROM CAOUTCHOUC.

He found it to depress the barometer like sulphuric ether. It passes through water without diminishing its volume, thus differing from ether. It is absorbed by water like olefiant gas. It consists of 2 olefiant gas. 10 vols. when burned give 40 carbonic acid, and require 60 of oxygen. It appears to be the same as a substance described by Faraday. It differs from coal gas in this, that the latter consists of double olefiant gas.

The observations of Mr. Davy upon this subject corresponded with those of Dr. Dalton.

Wednesday, August 12th.

11. MR. J. MALLET DESCRIBED THE PHENOMENA PRESENTED IN LAMPS,

When the holes for the passage of the gas are made as small as possible, and also the appearance observed when the direction of the tube is inclined in different ways, two currents being formed when the tube is inclined, and the surface of the flame presenting spiral lines, and considerable retraction of the flame taking place, none, however, occurring when the tube is not fully inserted. The apertures in the lamp were less than the $\frac{1}{100}$ of an inch in diameter.

In the discussion which arose from this communication, Dr. Dalton observed, that 12 small holes in a lamp consumed less gas and gave more heat than when the holes were larger but fewer in number. But the great object in procuring a proper quantity of heat depends upon the atmospheric air being neither too great nor small in quantity. He stated, that if we take a cubic inch of pure gas, and another diluted with half its volume of air, each gives out the same quantity of heat, but the latter scarcely yields any light. This is an important fact, and deserves to be known.

12. MR. CONNELL READ A PAPER IN WHICH IT WAS HIS OBJECT TO POINT OUT SOME CHEMICAL FACTS,

By which we may be enabled to detect, whether a fossil scale be that of a fish, or sauroid animal, and illustrated his position by some analyses which he had made on recent crocodile and fish scales, and upon the scales found at Burdie House. His inference was, that chemical analysis completely verified the idea of Agassiz, that the scales found at Burdie House were those of fish. He considers the animal matter to be replaced by a little carbonate of lime and silica.

13. MR. KANE DESCRIBED TWO COMPOUNDS OF TIN AND PLATINUM FORMED BY THE ACTION OF PROTOCHLORIDE OF TIN UPON A SOLUTION OF PLATINUM.

One of these compounds consists of an atom of each chloride. It deliquesces in the air; is a dark solid substance when anhydrous, and when allowed to remain in the air is converted into an olive liquor, which is resolved into the oxides by the action of water. The author suggested that tin affords a good test for platinum.

14. MR. SNOW HARRIS EXHIBITED AN APPARATUS OR MODIFIED ELECTROMETER, FOR PERFORMING THE EXPERIMENTS OF POUILLET, BY WHICH THE INSULATION OF THE GOLD LEAVES IS RENDERED INDEPENDENT OF THE GLASS, BY MEANS OF TWO RODS, TERMINATING IN GILDED BALLS.

To determine whether electricity is developed during the evaporation of water or any liquid, a platinum crucible, containing the substance to be examined, is placed upon the cap of the electrometer, having one of Deluc's small piles communicating with the rods. His results were contrary to those of Pouillet.

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15. DR. NEWBIGGING MADE SOME OBSERVATIONS UPON AN EXPERIMENT WHICH HE HAD MADE WITH REGARD TO THE COLOUR OF ARTERIAL BLOOD.

He placed some blood in a cup containing green spots on its surface. The portions opposite to these spots assumed a vermilion colour, but in no other part was this change visible.

Thursday, 13*th August*.

16. MR. HARTOP MADE SOME OBSERVATIONS ON THE EFFECT OF THE HOT AIR BLAST, WHEN APPLIED TO THE MANUFACTURE OF IRON.

He opposed some of the statements made by Dr. Clark at the last meeting of the Association, relative to the product and the quality of the iron; the former having been overrated, and the latter being decidedly inferior, as far as Yorkshire was concerned.

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17. DR. APJOHN EXPLAINED A FORMULA FOR ASCERTAINING THE SPECIFIC HEAT OF GASES; THE EXPRESSION BEING

$$f'=f\frac{48\,a\,d}{e}\times\frac{p}{30}$$

He has found it to correspond almost exactly with experiment. He modifies it to

$$a=\frac{(f'-f'')e}{48\,d}\times\frac{30}{p}$$

If the air be quite dry, the f'' (which expresses the elastic force of vapour at the dew point) will be unnecessary, and the formula becomes

$$a=\frac{f'\times e}{48\,d}\times\frac{30}{p}*$$

The experiments were made by means of a syphon with short horizontal arms. Sulphuric acid was introduced into the legs. Two bladders, the one filled with common air, and the other with the gas to be experimented on, were attached to one of the arms, and two thermometers, the one with a moist bulb, and the other dry, were introduced into the other leg. The bladder was then pressed, and the air forced through the acid. It passed over the thermometers, and gave the temperature of the gas at the dew point. This enabled the value of a to be determined, or the specific heat. A correction was made for the impurity of the gas, which was transmitted over mercury and analysed. Most of the experiments corresponded with those of the French chemists, except in one or two instances. The general result obtained was, that under equal weights, the gases have the same specific heat; and, under equal volumes, the specific heat is proportional to the specific gravity, except with hydrogen, which, under equal volumes, has double the specific heat.

The results are presented in the following table:—

	SP. HEAT, VOLUMES.	SP. GR.	SP. HEAT.
Air	1·000	1·000	1·000
Azote	·9613	0·0694	·9877
Hydrogen	·1315	·9722	I·8948
Carbonic oxide ·	1·0508	·9722	1·0808
Carbonic acid · ·	1·667	1·5277	1·0916
Nitrous oxide . ·	1·5277	1·5277	1·1652

$$a=\frac{e\,f'}{48\,d}\times\frac{30}{p}$$

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18. DR. DALTON INTRODUCED THE SUBJECT OF A SYSTEM OF CHEMICAL SYMBOLS, BY EXPLAINING HIS IDEAS RESPECTING THE COMPOSITION OF THE SIMPLE COMPOUNDS, AND EXHIBITED THE EXPRESSIONS WHICH HE PROPOSED MANY YEARS AGO, TO GIVE A PICTORIAL VIEW OF THE MODE IN WHICH THE ATOMS ARE COLLOCATED.

He considers the composition of nitrous oxide to be 2 atoms azote, adopted by Berzelius, who has not stated from whom he obtained it. Olefiant gas, he considers, is composed of single atoms of carbon and hydrogen, while the gas which exists in coal, though commonly termed olefiant gas, is, in reality, double olefiant gas, and is termed by Dr. Dalton, bin-olefiant gas. This is proved by its affording twice the quantity of carbonic acid, and requiring twice the quantity of oxygen, to burn it, which olefiant gas requires.

Mr. Whewell observed that the atoms might as well be supposed to be arranged in lines, as in the mode represented by Dalton, which was objected to by the latter, as being a tottering equilibrium.

Mr. Babbage recommended the publication of tables, representing the composition of substances by symbols,* with the addition of

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* These formulæ are elucidated in a paper in the last Volume of the Trans. of the Irish Academy.

* Berzelius is erroneously considered to have first introduced the use of letters to express briefly the composition of bodies. Dr. Thomson adopted this method in one of the earliest editions of his System of Chemistry, where he classified minerals according to their chemical composition. In his paper on Oxalic Acid, published in the Philosophical Transactions for 1807, he employs formulæ of this kind. Berzelius indeed, has owned, that he borrowed the idea from Dr. Thomson.

the different weights which have been brought forward, but without giving the sanction of the Association to them. He considered it proper that the algebraical formulæ should be adhered to as far as possible.

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19. Mr. MALLET SHEWED A BEAUTIFUL WHITE MATERIAL PREPARED FROM TURF, WHICH WAS DECLARED BY A PAPER-MAKER TO BE PERFECTLY FITTED FOR THE MANUFACTURE OF PAPER.

The upper stratum of turf, which covers immense tracts in Ireland, consists of layers. It is acted on by water to separate the leaves; then by caustic potash or soda; then by an acid. It is then bleached by chloride of lime. During the process a substance is obtained possessing the odour of camphor, mixed with that of turpentine, which is fluid at 290° F. The upper stratum of turf may also be employed for mill boards, after being soaked in glue and pressed by a hydraulic press.

Friday, 14*th August*.

20. Mr. DAVY DESCRIBED SOME EXPERIMENTS WHICH HE HAD MADE IN REFERENCE TO THE RELATIVE VALUES OF VIRGINIAN AND IRISH TOBACCO.

He procured nicotine by simply digesting the leaves in potash, and then distilling. A liquid possessing uniform qualities passed over. The liquid is acted on by acids, affording salts possessing a sharp biting state. The effect of the liquid was tried upon different animals, and found to be highly narcotic. He found that 1 lb. of Virginian tobacco was equivalent to $2\frac{1}{3}$ of Irish tobacco; the root containing 4 or 5 per cent. of nicotine. The usual estimate of the relative values, by dealers, is as 1 to 2.

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21. Mr. SCANLAN DETAILED THE EXPERIMENTS WHICH HE HAD MADE UPON WHAT HE CONSIDERED A NEW FLUID, PREPARED FROM PYROLIGNEOUS ACID BY SATURATION WITH LIME, DISTILLATION AND PURIFICATION BY CHARCOAL.

He found its boiling point to remain steady at 130°. The following table exhibits its peculiarities when compared with pyro-acetic and pyroxylic spirits.

	Sp. Gr.	Boiling Point.
Pyro-acetic. . . ,	·828	150°
Pyroxylic	·750	140°
New Fluid	·906	130°

Another fluid was obtained likewise which appeared to be new, exhibiting a strong action with caustic potash. It was suggested, that the first fluid was acetate of methylene, the specific gravity of which is ·919 and the boiling point 136°. The arguments of Mr. Scanlan were admitted by the Section to be conclusive, in favour of the substance being distinct from pyro-acetic, or pyroxylic spirits.

22. Mr. MOOR MENTIONED A CURIOUS CIRCUMSTANCE IN REFERENCE TO THE CORROSION OF LEAD PIPES.

The worm of a still used for preparing medicated waters, was exhibited, which was corroded completely through its substance, at those points where it had been supported with wood and tied with twine. At these points a black substance was formed, consisting of oxide and chloride of lead. It was obvious that the effect was to be attributed to galvanic action.

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23. Dr. BARKER DESCRIBED A NEW MODE OF SEPARATING THE PEROXIDE OF IRON BY MEANS OF ACETATE OF POTASH.

The latter salt, when added to a solution of per-salt of iron, precipitates the peroxide when the liquid is boiled. This would appear to afford an elegant method of separating iron from manganese.

He made an observation relative to the precipitation of magnesia by phosphate and carbonate of ammonia: viz. that the same precipitation takes place with bi-carbonate of potash, and other salts.

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24. Dr. GEOGHEHAN SUGGESTED THE ADVANTAGE OF EMPLOYING THE DOUBLE SALT OF IODIDE OF POTASSIUM AND BICYANIDE OF MERCURY, FOR THE PURPOSE OF DETECTING MURIATIC ACID IN PRUSSIC ACID.

Sulphuric acid is frequently met with in prussic acid, but the distinction between these two acids is readily made, by means of nitrate of barytes. The peroxide of mercury usually employed for testing the purity of prussic acid is ambiguous in its action, as it is usually impure. The use of this salt is not applicable to the alcoholic prussic acid.

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25. Mr. JOHNSTON MADE SOME OBSERVATIONS ON THE IODIDES OF GOLD, WHICH HE HAD ANALYZED.

Their composition is similar to the chlorides. Previous errors, he found, were to be ascribed to the precipitation of an excess of gold, when ammonia was employed in the analysis.

There are three compounds, viz. (1.) Au I; (2.) Au 3 I; (3.) Au 3 I + K I, the atom of gold being 25.

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26. Dr. WILLIAM BARKER MADE SOME OBSERVATIONS ON THE PASSAGE OF ELECTRICITY ALONG A PLATINUM WIRE.

Black spots were observed at regular distances, the rest of the wire being luminous.

27. Mr. SCANLAN EXHIBITED A BEAUTIFUL SPECIMEN OF HEMATINE CRYSTALLIZED IN THE CENTRE OF A MASS OF LOGWOOD.—*Records of General Science*, 1835.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY OF LONDON, FOR 1835. PART I.

PHYSICS.

NOTE ON THE ELECTRICAL RELATIONS OF CERTAIN METALS AND METALLIFEROUS MINERALS. BY R. W. FOX.

The author states that the crystallized gray oxide of manganese holds the highest place in the electro-negative scale of any substance examined, when it is immersed in various acid and alkaline solutions; and the other metals and minerals rank after it in the following order: manganese, rhodium, loadstone, platinum, arsenical pyrites, plumbago, iron pyrites, arsenical cobalt, copper pyrites, purple copper, galena, standard gold, vitreous copper, silver, copper, pan brass, sheet iron. When employed in voltaic combination he found that on being so arranged as to act in opposition to one another, the direction of the resultant of their action, as indicated by the deflection of the magnetic needle, did not coincide with the mean of the direction of the needle when under the separate influence of each. He concludes, therefore, that the needle does not indicate the whole of the electricity transmitted, and that electro-magnetic action does not depend upon a continuous electric current, but is better explained on the hypothesis of pulsations, formerly advanced by him.

EXPERIMENTAL RESEARCHES ON ELECTRICITY, NINTH SERIES. BY MICHAEL FARADAY, D.C.L. &c.

The inquiry which produced the development of the facts contained in this paper arose from the observation of Mr. Jenkin, that, if an ordinary short wire be employed to form a communication between the two plates of an electrometer consisting of a single pair of metals, it is impossible to procure an electric shock, but if the wire which surrounds an electro-magnet be used, a shock is experienced whenever the contact with the electrometer ceases, if the extremities of the wires are held in the hand, while a brilliant spark appears at the point of disjunction. In the prosecution of his researches the author employed the conducting wire in four different modified forms: 1st, as the helix of an electro-magnet, consisting of a cylindrical bar of soft iron, 25 inches long and 1¾ inch in diameter, bent into a ring, which was soldered to a copper rod which served as a conducting continuation of the wire: 2nd, as an ordinary helix formed of a copper wire coiled round a pasteboard tube, the convolutions being separated by a string, and the superposed helices prevented from touching by intervening calico: 3rd, as a long extended wire, and 4th, as a short wire. Of all these forms, the brightest spark and most powerful shock are procured by inserting a cylinder of soft iron within the helix, so as to form an electro-magnet. He found, also, that if a current be established in a wire, and another wire forming a complete current be placed parallel to the first, at the moment the current in the first is stopped, it induces a current in the same direction in the second, the first exhibiting then but a feeble spark; but, if the second wire be removed, a current is induced in the first wire in the same direction, and a spark elicited when the contact is broken. The strong spark in the single long wire or helix, is therefore, the equivalent of the current which is induced in a second wire placed parallel and in connexion with the first wire. From the facility of transferences to neighbouring wires, and from effects generally, he considers the inductive forces to be lateral, *i. e.* excited in a direction perpendicular to the direction of the originating and produced current, and they also appear to be accurately represented by the magnetic curves, and closely related to, if not identical with magnetic forces. All experiments tend to shew that the elements of the currents do not act upon themselves, but excite currents in conducting matter which is lateral to them. On using a voltaic battery with fifty pairs of plates the effects were exactly similar to those with a single pair. The author concludes with remarking upon the advantages presented by electro-magnetic machines, in which the current is permitted to move in a complete metallic circuit of great length during the first instant of its formation, by which means great intensity is given by induction to the electricity which at that moment passes.

ON THE DETERMINATION OF THE TERMS IN THE DISTURBING FUNCTION, OF THE FOURTH ORDER, AS REGARDS THE ECCENTRICITIES AND INCLINATIONS WHICH GIVE RISE TO SECULAR INEQUALITIES. BY J. W. LUBBOCK.

In the theory of the secular inequalities, the terms in the disturbing function of the fourth order, as regards the inclinations, have hitherto been neglected. As the magnitude of these terms depends, in a great measure, upon certain numerical co-efficients, it is impossible to form any precise notion, *a priori*, with respect to their amount, and as to the error which may arise from neglecting them. The author has, therefore, considered it desirable to ascertain their analytical expressions. The details of this calculation form the subject of this paper.

ON CERTAIN PECULIARITIES IN THE DOUBLE REFRACTION, AND ABSORPTION OF LIGHT, EXHIBITED IN THE OXALATE OF CHROMIUM AND POTASH. BY SIR DAVID BREWSTER.

This salt occurs in flat irregular six-sided prisms, the two broadest faces being inclined

to each other like the faces of a wedge, whose sharp edge is the summit of the crystal. The broad faces are inclined upon the adjacent faces at an angle of 64°. The crystal is terminated by four minute planes, equally inclined to the broad faces and the axis of the prism, but two of the faces often disappear. The crystals are generally opaque, and at thickness not much above the $\frac{1}{25}$ th of an inch; they are quite impervious to the sun's rays. Their colour by reflected light is then nearly black; but their powder, in daylight, is *green*, and *French gray* by candle light. In the smaller crystals the colour is *blue*, both by reflected and transmitted light. The refractive index is about 1.605 and 1.506. At a certain small thickness the least refracted image is *bright blue*, and the *most* refracted image *bright green* in daylight, or *bright pink* in candle light. The blue, when analyzed, consists of a mixture of green, and the green an admixture of red.

At greater thicknesses the blue becomes purer and fainter, and the green passes into red; and at a certain thickness of the least refracted blue image disappears altogether, and the most refracted image is olive-green. At still greater thicknesses this image disappears also, and absolute opacity ensues. With polarized light, when the axis of the crystals is in the plane of polarization, the transmitted light is *green*, but when perpendicular it is *blue*. In solution the double refraction disappears, but the other appearances are observed as in the solid state. The crystal excites a specific action on the red ray between A & B of Fraunhofer; a sharp and narrow black band being formed, which constitutes a fixed line in all artificial lights. The relations of this salt to common and polarized light may be examined by placing upon a plate of glass a few drops of a saturated solution of it in water. If the crystals are slowly formed they will be found of various thicknesses, each thickness exhibiting a different colour, varying from perfect transparency through all shades of *pale-yellow*, *green*, and *blue*, in daylight, and through all shades of *pale-yellow*, *pale-orange*, *red*, and *blue* in candle-light.

SECOND ESSAY ON A GENERAL METHOD IN DYNAMICS. BY W. R. HAMILTON.

In his first Essay, the author observed, that many eliminations required by this method, in its first conception, might be avoided by a general transformation, introducing the time explicitly into a part S of the whole characteristic function V. In the present Essay he fixes his attention chiefly on this part S, and to call it the *principal function*. Its properties are more fully developed, especially in application to questions of perturbation, in which it enables us to express accurately the disturbed configuration of a system by the rules of undisturbed motion, if only the mutual components of velocities be changed in a suitable manner.

CONTINUATION OF A PAPER ON THE TWENTY-FIVE FEET ZENITH TELESCOPE, LATELY ERECTED AT THE ROYAL OBSERVATORY. BY JOHN POND.

The observations made by means of this instrument have confirmed the accuracy of the results obtained in determining the place of any star passing the meridian near the zenith.

We have now three methods of observing this: 1st, By the mural circles: 2nd, By the zenith telescope, used alternately east and west, and 3rd, by means of a small subsidiary star.

GEOMETRICAL INVESTIGATION CONCERNING THE PHENOMENA OF TERRESTRIAL MAGNETISM. BY T. S. DAVIES.

The present series of papers is chiefly intended to deduce the mathematical consequences of the theory of two poles situated arbitrarily within the earth, and especially to investigate the singular points and lines which result from the intersection of the earth's surface with other surfaces related to the magnetic poles, especially the points at which the needle is vertical, the lines of equal dip, the Halleyan lines, the isodynamic lines, and the Hansteen poles. He investigates at length the hypothesis of the duality of the terrestrial magnetic poles, and shews that the question cannot be determined definitely until the dipping needle is brought to a greater state of perfection and the influence of geological and meteorological sources of disturbance can be accurately appreciated.

RESEARCHES TOWARDS ESTABLISHING A THEORY OF THE DISPERSION OF LIGHT. BY THE REV BADEN POWELL.

An abstract of this paper has already appeared.

METEOROLOGY.

ON THE ATMOSPHERIC TIDES AND METEOROLOGY OF DUKHUN, (DECCAN), EAST INDIES. BY LIEUT-COLONEL W. H. SYKES.

This is a paper of great interest, as it contains a mass of facts accumulated with great labour and care, in a portion of the world where science, with the exception of botany, has hitherto been almost unknown. The author, in the first instance, proceeds to describe his instruments and his mode of proceeding to observation. These are important points, and deserve an attentive consideration. The proper mode of mounting meteorological instruments for observations in tropical climates is particularly adverted to. Ivory scales and reservoirs are proved to be useless; the substitution of metals being absolutely necessary. The conclusions to which the observations lead are principally as follow: In the Dukhun four atmospheric tides exist in the 24 hours; two diurnal and two nocturnal, each consisting of a maximum and minimum tide. These,

as compared with observations at the Royal Society, are

Nocturnal *falling* minimum tide from 10—11 P.M. to 4—5 A.M.	Diurnal maximum *falling* tide from 9—10 A.M. to 4—5 P.M.
Poonah .... —·0181	Poonah .... —·1166
Royal Society —·0162	Royal Society —·0289
Diurnal *rising* tide from 4—5 A.M. to 9—10 A.M.	Nocturnal maximum *rising* tide from 4—5 P.M. to 10—11 P.M.
Poonah ..... + ·0445	Poonah ..... + ·0884
Royal Society + ·0185	Royal Society + ·0272

These tides occur within the same limited hours as in America and Europe, the greatest mean diurnal oscillations taking place in the coldest months, and the smallest tides in the damp months of the monsoon; while at Madras the smallest oscillations are in the hottest months, and in Europe it is supposed the smallest oscillations are in the coldest months. The diurnal and nocturnal tides are regular whatever the thermometric or hygrometric indications may be, or whatever the state of the weather; storms and hurricanes only modifying them. The mean diurnal oscillations at Poonah, 1,823 feet high, are greater than at Madras. At a higher level than Poonah, the diurnal tides were less, while the nocturnal tides were greater. The maximum mean pressure of the atmosphere is greatest in December or January, then gradually diminishing until July or August, and subsequently increasing to the coldest months. The annual range of the thermometer is less in Dukhun than in Europe, but the diurnal range is much greater. The annual mean dew point is higher at 9h 30' than at sunrise or 4 P.M. The highest dew points occur in the monsoon, the lowest in the cold months. The rain in Dukhun is only 28 per cent. of the rain in Bombay (Records. vol. i. p. 291.) ninety or a hundred miles to the east. Fogs are rare, and are always dissipated by 9—10 A.M. *Circular* and white rainbows occur; solar radiation is very great; the atmosphere is very opaque in hot weather, and the mirage is distinct.—*Records of Science.*

ELECTRICAL THEORY OF THE UNIVERSE. BY MR. THOMAS S. MACKINTOSH.

We beg to call the attention of our readers to the following paper by Mr. Mackintosh. It is our intention to continue the subject in every number.

The whole economy of nature, so far as we know, is guided by one general principle—production, destruction, and reproduction. Throughout animated nature this rule holds without exception—" one generation passeth away and another cometh,"—nothing is stationary—all is in a state of progression. The rule holds with the same force in vegetable life; and in the mineral kingdom, although the progression is slower and less obvious to the general observer, yet, so far as we are acquainted with it, the progression is exactly the same. If this rule holds throughout all the works of nature with which we are acquainted, the inference is just and well founded, that the same rule and order may hold also in these higher and more remote operations with which we are to a certain extent unacquainted.

The author of the following theory has been led into this train of reflection from observing the very vague and futile uses which some philosophers have assigned to comets in the general economy of nature. Some have informed us with all due gravity, that they may possibly be abodes prepared for the reception of the wicked, where they will be exposed alternately to the pain and misery of extreme heat and cold. This theory is beyond the sphere of natural philosophy. Others have supposed that they are destined at some future time to be used as agents in the destruction of this planet. Now I hold it to be a physical impossibility that a comet can ever approach this earth sufficiently near even to disturb the settled order of the seasons in any material degree, much less to cause its utter destruction. Comets, in my opinion, are not agents for the destruction or derangement of any of the planets in the solar system; but, on the contrary, very important and essential instruments for their regeneration.

I am aware that various hypotheses have been, from time to time, submitted to the world upon this subject; but, unfortunately, their authors have endeavoured to draw their corroborations from sources entirely foreign to natural philosophy. They have perplexed themselves in forming hypotheses that should accord in all their parts with the Mosaic accounts of the creation and universal deluge. They imagined that their theories demanded credence, and derived support in proportion as they could be strained to coincide with the Holy Scriptures; and that the truth of the Scriptures was attested by corroborations drawn from natural philosophy: now, in my opinion, the Scriptures stand in no need of such aid, and natural philosophy has no right to seek support from writings of divine inspiration. Every kind of work must be judged by the congruity of its parts, and the facts and arguments adduced in support of the proposition sought to be established; but if we apply the same rule to the different theories of the universe that have been submitted to our judgment, we shall find little difficulty in discovering discrepancy sufficient to invalidate the whole hypotheses. However, it is not our present business to show that the theories of our predecessors are erroneous; we will leave them to the judgment of the world, by which this also must be tried.

This sketch is published rather with a view to elicit the opinions of scientific men upon the subject than to establish a theory. With regard to the mere theory, perhaps no one cares less than the author himself, and if the voice of the scientific world should pronounce it visionary and absurd, no one will smile with more complacency. If the appearances of truth or probability shall be found in the estimation of the world in favour of his system, it will gain ground in every discussion that may ensue upon its promulgation; on the other hand, if the appearances of probability shall be found against it, it will soon be consigned to oblivion.

Theory of Matter.

All matter contained in the solar system, of whatever description, has, at one time or other, emanated from the sun, into whose body it will again return, again to emanate, again to return, and so on *ad infinitum.*

1. A comet is an immense volume of aeriform or gaseous matter, in a highly electrified state, expelled from the sun by an extraordinary effort; and is the result of certain specific modifications of electricity in due accordance with the laws of nature.

2. A comet is projected from the sun in an elliptical curve; and the eccentricity of its orbit is determined conjointly by the sun's rotatory motion, and the tangent at which it is at first projected.

3. In the course of a series of revolutions the component parts of a comet become more dense and compacted, its orbit less elliptical, its projected distance from, and its approximation to, the sun become less in nearly an equal ratio.

4. When the orbit of a comet has become nearly a circle, and its component parts are sufficiently settled and condensed, it takes its station on the verge of the solar system and becomes a planet.

5. When several comets are matured and settle into the planetary state about the same time, the largest and densest of the group becomes the primary, attracts the smaller comets to its sphere, and these become its secondaries.

6. Through every successive revolution the secondaries approximate nearer and nearer to, and ultimately fall into, the body of their primaries.

7. The planets through every successive revolution approximate nearer and nearer to, and ultimately fall into, the body of the sun.

Theory of Motion.

All motion throughout the solar system is effected by the agency of electricity, both the larger operations exhibited in the motion of the planets and the minuter processes of vegetation, oxidation, and vitrification; and each specific and distinct mode of motion or action is caused and directed by specifically distinct modifications of electricity, the relative circumstances controlling its operations being appreciated.

1. The earth and all the planets of the solar system are maintained at their respective distances from the sun and from each other by the relative proportions of positive and negative electricity with which each is charged.

2. In carrying on the vegetative and other processes of nature, the electric fluid of the earth and other planets is gradually dissipated, and the repulsive power between the sun and planets is weakened in a corresponding ratio.

3. As the electric fluid of Mercury, Venus, the Earth, and other planets, becomes each necessarily exhausted, the repulsive power will become extinct, and each will, in the order of their succession, merge in the body of the sun.

4. In like manner, as the electric fluid of the moon and other secondaries becomes exhausted, the repulsive force between the primaries and their secondaries will become extinct, the moon will merge in the earth, and each secondary will mèrge in the body of its primary.

5. The earth's rotatory motion is an effect of the electrical agency of the sun acting upon electrical matter contained and circulating within the cavernous body of the earth, and diffused throughout the external crust composing the earth's surface.

6. As the earth and other planets are continually approximating towards the sun in spiral orbits, they are in effect propelled down an inclined plane by the power of electricity.

There are two theories of electricity; one is called the Franklinian theory, from being proposed by Dr. Benjamin Franklin, wherein it is assumed:—

1. That there exists in all bodies a subtle fluid called the electric fluid.

2. That some bodies called conductors are capable of holding or retaining a larger quantity of electricity than other bodies called non-conductors.

3. That non-conductors have so little affinity for electricity, that the quantity they contain can be extracted from them by friction, and transferred to conducting bodies, which have more affinity for electricity.

4. That the body that is filled or positively charged with electricity will attract the body that is emptied or negatively charged; and that the attraction will be powerful or weak in proportion as the positive body contains more, or the negative body less, than its natural quantity of electricity.

5. That two bodies, both filled or positively charged with electricity, will repel each other.

6. That two bodies, both emptied or negatively charged with electricity, will repel each other.

It is objected to the 6th article of this theory, that as two bodies both emptied of electricity repel each other, the electric fluid cannot be the cause of this repulsion, seeing they are both emptied. Some attempt to explain this difficulty by saying, that if the electric fluid be withdrawn, matter has an affinity for, and will attract, other matter;

and that it is only prevented from doing so by the repulsive power of the electric fluid with which all bodies are charged or filled in their natural state.

Others, not content with this explanation, have recourse to another theory, proposed by Du Fay, which assumes that there are two electric fluids, one called the vitreous and the other the resinous. The explanation of this theory is a mere repetition of the first with a change of terms, vitreous being substituted for positive, and resinous for negative electricity. However, as a clear comprehension of the known laws of electricity is essential to a right understanding of this theory of the solar system, we will state Du Fay's theory of the two electricities :—

1. If a cylinder of smooth glass is excited by friction, vitreous electricity is obtained.

2. If a cylinder of sealing-wax is excited, resinous electricity is obtained.

3. Two bodies charged with vitreous electricity will repel each otner.

4. Two bodies charged with resinous electricity will repel each other.

5. Two bodies, the one charged with vitreous and the other with resinous electricity, will attract each other.

The state of our knowledge in the science of electricity is not sufficiently advanced to enable scientific men to pronounce with certainty which of these two theories is the true one, although Du Fay's is generally considered to be nearest the truth ; but Franklin's is often preferred in treating on the subject, on account of its greater simplicity, and on that account we shall adopt Franklin's terms of positive and negative in the present case, without offering any opinion as to the truth of either theory. We should prefer that of Du Fay, and are of opinion that it would square much better with our own than Franklin's ; but minds unaccustomed to the science are apt to get confused amongst the various substances having greater affinities for the one or the other species of electricity. To the scientific reader either theory is alike acceptable, as he can readily change the terms, and the application becomes nearly the same.

Setting aside all theory for the present, we will proceed to examine such general facts relating to the science of electricity as have been developed and confirmed by the experiments of scientific men. These general facts are usually reduced to the six following heads :—1. Excitation ; 2. Attraction ; 3. Repulsion ; 4. Distribution ; 5. Transference ; 6. Induction.

1. Excitation—" If a piece of amber or sealing-wax or a smooth surface of glass, perfectly clean and dry, be briskly rubbed with a dry woollen cloth, and immediately after held over small light bodies, such as pieces of paper, thread, cork, straw, feathers, or fragments of gold leaf, strewed upon a table, these bodies will be seen to fly towards the surface that has been rubbed, and adhere to it for a certain time. The surfaces which have acquired by friction this attractive power, are said to be *excited*, and the substances, thus susceptible of excitation, are termed *electrics*, in contra-distinction to such as are not excitable by a similar process, and which are therefore termed *non-electrics*." In the tables of conducting and non-conducting bodies, gold is usually placed at the head of the list of non-electrics, and is considered the best known conductor of electricity ; at the head of the list of electrics is placed gum-lac, which is considered the best insulating body or non-conductor. But in the electrical machines, a glass cylinder is commonly used as an electric, and a hollow brass cone, each end terminating in a hemisphere, as a conductor. The glass cylinder is mounted on an axis and supported by two glass pillars, for the purpose of insulating it or cutting off the communication between the cylinder and the earth, as electricity will not pass through the glass pillars, that substance being a non-conductor. The handle by which the cylinder is turned must also be of glass, otherwise the electricity will pass into the earth through the arm and body of the operator. These arrangements being made, if the handle be turned round briskly, and a piece of silk or woollen cloth be held against the cylinder with a pressure sufficient to cause a moderate degree of friction upon the surface of the glass, electricity will be accumulated in the cylinder. This is the process of excitation. We know nothing whatever of the nature of this process ; all that we know is, that with the same arrangements and means electricity is invariably accumulated in the glass cylinder, and that is sufficient for our present purpose.

2 and 3. attraction and repulsion.—The glass cylinder being now charged with positive electricity, or filled with electric fluid, will attract the metallic conductor, which is in its natural state ; but if the conductor be negatively charged or emptied of the electric fluid, the attraction between the two bodies will be proportionately more powerful and intense ; if the negative conductor be now presented to the positive electric, a portion of the redundant fluid will be transferred to the conductor, and the two bodies being both positively electrified, will repel each other ; the same effect will be produced if the bodies are placed at a certain distance, and a metal ball suspended between by means of a silk thread, or any other insulating substance, the ball will be attracted and repelled by each, alternately, until the electric fluid is reduced to an equilibrium in the two bodies, the ball extracting the fluid from the full body and carrying it to the empty one until this is accomplished. The manner in which this is effected must be particularly noted, as we shall have occasion to refer to it when we come to treat of comets.

4. distribution.—It has been ascertained by experiment, that in bodies charged with electricity, it is not distributed equally throughout the mass, the quantity a body is capable of receiving, depending more upon the extent of surface than the soild contents ;

that a metallic conductor in the form of a globe contains just as much electricity when hollow as is it does when solid. It therefore appears that the electric fluid resides chiefly in the surface of the body; and hence we may conclude, that the active electricity with which the earth is charged, is almost wholly diffused throughout the external crust composing the earth's surface. We shall have occasion to notice this peculiarity when we come to treat of the earth's motion on her axis.

5. Transference.—We have seen, that if a body be filled or charged with electricity, and an empty body brought in contact with it, the redundant fluid will be transferred from the one body to the other; and that there is a continual tendency in the two bodies to effect this transference is evinced by their attraction for each other; and if the two bodies are allowed to come in contact with the earth, the whole charge will be drawn off into the earth, which is the great conductor and reservoir of electricity.

6. Induction.—The reader will find an explanation of this law in a future number.

It is absolutely necessary before entering upon the following theory, that clear and correct ideas of the sciences of electricity and of the galvanic circle, should be formed in the mind of the reader; and if he is somewhat acquainted with chemistry, he will be able to draw deductions for himself from this knowledge, which are not adverted to in this short treatise; in short the whole circle of the physical sciences lend their aid and support to the hypothesis that follows, and had our own knowledge extended farther, we should undoubtedly have been enabled to furnish arguments still more convincing than those that have been adduced; but we are satisfied that the fundamental principle of our theory is correct, that the arguments advanced (and they are but a small number compared with the vast body that might be collected by a more intimate and extended knowledge of the electro-chemical operations of nature in her own vast laboratory), must carry conviction home to every philosophic mind. In the leading principles of theory, we find that they conform very closely to those of Sir Isaac Newton, and we point to this feature with no small satisfaction. Newton explained the effects with precision, but he failed in not tracing the cause of motion to the all-pervading power of electricity: this defect must be considered as arising from the circumstance of electricity being almost wholly unknown as a science in the days of Newton, otherwise it could not have escaped the search of his powerful and discriminating mind. The materials from which he drew his deduction were few and scanty, compared with the stores that have since been opened to our view by the laborious researches of scientific men, but he made the most of his meagre stock, and found his way to the Temple of Science by intricate and narrow paths, with a certainty and precision most wonderful; he opened the way, and enabled us to proceed with some degree of confidence; and we humbly presume, that in the following theory we have advanced one step in the path of science.

It is further necessary that a slight acquaintance with astronomy should be obtained in order to understand this theory correctly. It will be sufficient for this purpose to know that the sun is fixed in the centre of the solar system; that he revolves on his axis in twenty five days; that he is more than a million times larger than the earth, and that there is evidence of his being composed of the most active elements; that he is surrounded by planets which appear to be of a nature similar to this earth; that these planets revolve round the sun in a circular orbit, forming their years and seasons, and also turn on their axis forming days and nights, and that some of these planets have also smaller bodies, called moons or satellites, revolving round these somewhat in the same manner.—*Mechanics' Magazine*, 1835.

(To be continued.)

THE INDIA REVIEW.

Calcutta: September 1, 1836.

PROPOSAL FOR THE ESTABLISHMENT OF A CALCUTTA COMPANY FOR STEAM NAVIGATION.

Various attempts have been made to establish communication by steam navigation between Calcutta and England, but, we regret to say, without effect; while at so small a settlement as the Isle of France there is every prospect of vessels steaming between that place and the Cape as well as Bombay. Now, what is the cause of the failure of these attempts, at the capital of India, to attain such a desirable object?

The failure appears to us to have arisen from the circumstances of calling upon the people here to subscribe for such an object, without holding out the promise of ulterior gain for the amount of their subscriptions. The mere prospect of seeing one steamer and a passage expected within a given time is not sufficient to induce persons to come forward with the required pecuniary contributions. The great object of the commercial community here, if it desires to compete with

other nations, would be to institute a society solely for steam communication from port to port in the Eastern seas as well as to Europe; affording to share-holders a prospect of large returns for capital sunk in such an undertaking. The Government of India has already shewn what is the beneficial result of establishing steam boats on the river, which have, we understand, realized large profits on the first outlay; and if similar beneficial results, as has been stated to have arisen from the gain derived by the last voyage of the *Hugh Lindsay*, were pointed out, surely there would be no want of share-holders the moment the intention of establishing a society for steam navigation was announced throughout the vast territories of India.

We are aware of the objection to the formation of companies, that they are looked upon in the light of monopolies, and that as their privileges have been lessened, advantages have increased towards free and general trade. But we are not advocating joint stock companies to be incorporated with exclusive privileges, but such associations which are acknowledged to be the parents of all foreign commerce, where private traders would be discouraged from hazarding their fortunes until the method of steam navigation has been first settled by establishing a company on liberal principles, that is to say, under regulations by which it may be easy for all classes of persons to be admitted, and effectually guarding against the evils of restrictions of trade. If some of the leading men of this city were to meet and propose a company to be ormed, the object would certainly be attained. Whatever may be the amount of the capital, that of shares should be small. We are aware there are many who will entertain doubts whether such a speculation would prove profitable, so great will be the capital required. The best answer to be given to clear away such doubts is, the incalculable numbers of steam vessels which have been built and are building in America, France, and Britain. If the speculation had not succeeded beyond all expectation in those countries, we will venture to say, the building of steamers would have ceased.

To shew the enormous sum of energy, talent, skill, and money of joint stock companies in our native land during 1825, we extract from the February number of the Magazine of Popular Science the following list of the projects recommended by their several patrons, as eligible means of investing capital. In this list there appears an India and London Steam Navigation Company, of which, strange to say, we know little here. We know there was a project of the kind entertained: it ought unquestionably to be established here.

BANKS.

Agricultural and Commercial Bank of Ireland, £ 1,000,000, Bank of South Africa, 150,000, Total, £ 1,150,000.

STEAM.

British and American Intercourse Company (sea part), £ 756,000, British and American Steam Navigation Company, 500,000, British and Foreign Steam Navigation Company, 200,000, Canterbury, Dover, and London Steam Packet Company, 15,000, Equitable Steam Packet Company, 120,000, India and London Steam Navigation Company, 120,000, Leghorn Steam Navigation Company, 28,000, Mediterranean and Levant Steam Packet Company, 100,000, Patent Paddle-Wheels Steam Towing Company, 30,000, Steam Carriages on Turnpike Roads, 20,000, Total, £ 1,889,000.

GAS.

European Gas Company, £ 200,000, Greenwich and London Railway Gas Company, 20,000, Marylebone Gaslight and Coke Company, 75,000, Total, £ 295,000.

MINES.

Baldhu and Wheal Tregothnau (Tin and Copper), £ 15,000, Bissoe-bridge (Tin and Copper), 20,000, Candonga, 200,000, Combmartin (Lead, Silver, and Copper), 30,000, Chilton Coal Company, 50,000, Copiapo (Copper and Silver), 200,000, Carn Grey (Tin), 2,500, East Cornwall (Silver), 50,000, Enterprise Mining Company, 20,000, Equitable Mexican Association (Gold), 50,000, Hayle Consols (Copper), 30,000, Kelleweris (Copper), 60,000, Kerrow (Tin), 10,000, New South Hooe, 20,000, New Crinis (Tin and Copper), 20,000, New Granada (Silver), 20,000, North Cornwall (Silver, Lead, and Tin), 40,000, Polbreen (Tin and Copper), 30,000, Perran Consols, 30,000, Pike Silver Mining Company, 112,500, Redruth (Tin and Copper), 100,000, Roche Rock (Tin), 30,000 Royal Copper Mines of Cobre, 480,000, Relistian Mining Company, 30,000, St. Hilary (Copper), 20,000, St. Geny's (Copper), 19,200, South Polgooth (Tin and Copper), 20,000, Sierra Mining Company (Gold and Silver), 120,000, Treleigh Consolidated (Copper), 25,000, Towan Consolidated (Tin and Copper), 30,000, Terra Putina (Gold), 500,000, Tavistock (Copper), 25,000, Trevorgus (Silver, Copper, and Lead), 30,000, Towedteague (Tin), 25,000, West Tresaveau (Tin and Copper), 60,000, Wendron Royal (Tin), 16,000, West Cork Mining Company, 220,000, Wheal

Brothers (Copper, Tin, Lead, and Silver), 110,000, Wheal Gilbert (Tin and Copper), 15,000, Wrexham Iron and Coal Company, 60,000, Wheals Harmony and Montague (Copper and Tin), 50,000, Total, £ 3,006,200.

RAILWAYS.

Altona, Hamburgh, and Lubeck, £ 300,000, Birmingham and Gloucester, 750,00, Bristol and Exeter, 1,500,000, Birmingham, Bristol, and Thames Junction, 150,000, Brighton and London (Palmer's), 2,100,000, Brighton and London (Gibb's) 900,000, Brighton and London (Stevenson's) 1,000,000, Brighton and London (Cundy's), 700,000, British and American Intercourse (land part), 1,244,000, Blackwall and London, 400,000, Blackwall Commercial, 600,000, Calcutta and Saugor, 500,000, Croydon and London, 140,000, Dover and London, 1,000,000, Eastern Counties, 1,500,000, Gravesend and London, 600,000, Great Western, 3,000,000, Grand Atlantic, 3,000,000, Grand Surrey Canal and Junction, 600,000, Great Northern, 3,000,000, Grand Northern, 4,000,000, Hull and Selby, 270,000 La Loire, 140,000, Llanelly, 200,000, London Grand Junction, 600,000, National Pneumatic, 200,000, North Midland, 1,250,000, North of England, 1,000,000, Preston and Wyre, 130,000, South Eastern, 1,400,000, Southampton, 1,000,000, South Durham, 150,000, South-West Durham Junction, 50,000, Southend and Hole Haven, 300,000, Tower of London, 1,000,000, Thames Haven, 450,000, Windsor and London, 300,000, Total, £ 35,424,000.

MISCELLANEOUS.

Anti Dry Rot Company, £ 250,000, Bognor Improvement Company, 200,000, British Agricultural Loan Company, 2,100,000, Cornwall Royal Tin Smelting Company, 100,000, Deptford Pier and Improvement Company, 50,000, Danube and Mayne Canal Company, 833,000, Equitable Discount Society, 100,000, Equitable Society, 210,000, Equitable Reversionary Interest Society, 300,000, Eastern Metropolitan, Surrey, Kent, and Sussex Society, 150,000, Gravesend River Thames Floating Bath Company, 20,000, Hastings Improvement Company, 200,000, Imperial Anglo-Brazilian Canal, Road, Bridge, and Land Improvement Company, 500,000, London Reversionary Interest Society, 400,000, Licensed Victuallers' Fire and Life Insurance, 150,000, Mexican and South American Company, 100,000, Metropolis Pure Soft Spring Water Company, 300,000, National Provident Institution. Norwood Park Estate, 20,000, Pennsylvania Coal, Land and Timber Company, 135,000, Prospective Endowment Association, 1,000,000, Patent White Lead Company, 100,000, Rio De Anori Gold Stream-works Company, 25,000, Shetland Fishery Association, 100,000, South London Market Company, 250,000, South of England Reversionary Interest Association, 50,000, South Australian Company, 500,000, United Investment Company 50,000, Total, £8,193,000.

SUMMARY.

Banks, £1,150,000, Steam, 1,889,000, Gas, 295,000, Mines, 3,006,200, Railways, 35,424,000, Miscellaneous, 8,193,000, Total, £49,957,200.

PROGRESS OF SCIENCE,

AS APPLICABLE TO THE ARTS AND MANUFACTURES; TO COMMERCE AND TO AGRICULTURE.

HISTORICAL RETROSPECT OF THE CAOUTCHOUC MANUFACTURE.

In every view the rise and progress of a new manufacture is an interesting object of contemplation, and especially so when employed on a new material. Whether we consider it as indicating the progress of man in subduing the powers and properties of nature to his uses, or as establishing by new instances the adaptedness of the material creation to the supply of our wants and the improvement of our faculties; or as furnishing new ties of brotherhood between men and nations by the mutual dependency for the gratification of new desires; or as evidencing the illimitable increase of human wishes and efforts; or as showing the beneficence of the providential movements by which the skill, the perseverance (perchance the infatuated perseverance) of one man in a far-off corner of the world provides a market for the labour of thousands, wandering before in wild and naked want, and gives in return, knowledge and civilization, and their countless and inestimable consequences: In any of these aspects the adaptation of a new material to the wants or even the whims of civilised society is an event full of interest to the philosopher, the patriot, and the Christian.

The struggling inventor himself is usually beset with cares and difficulties. To extort from nature her secrets, and to riddle out of the heaps which art has gathered, the precious grains of knowledge that he needs, to bear the jeers of the ignorant, the superciliousness of the purse-proud, and the pitiful advice of the prudent: these are his toils and his trials—troubles sweetened only by enthusiastic hope, the confident convic-

tion of yet unseen success "which maketh not ashamed."

When his plans are fully before the world, and incredulity can no longer deny his success, nor ignorance itself mistake it, unmoving prejudice stands across his path, and forbids him his reward. His trials, however, have taught him to triumph by perseverance; public opinion pronounces his title to recompense; when some foul, lurking, perhaps wealthy, plagiarist, shrinking from no villany if it be but gainful, seizes on some quirk of law, robs him of his right, and employs his scoundrel purse to defend the rank iniquity.

Such is too often the history of inventions and inventors. We have been reminded of some of its features by the inquiries recent and unexpected events have induced us to make into the progress of the manufacture of caoutchouc.

This substance seems to have been first brought into Europe, or at least to have attracted the attention of men of science, about the middle of last century. It was then imported, and, indeed, known only in the solid state; and it was not till many years after it was first received, that it was certainly known not to be an artificial production. Several French philosophers examined it, and gave memoirs upon it; but its use was confined to the well-known one of rubbing out the marks of blacklead pencils, from which it derived its name of Indian rubber. A letter of Dr. Priestley's mentions it as a rarity, and says that it was sold by Nairne, of the Royal Exchange; the price of a cube of about half an inch on a side being three shillings and sixpence—somewhat more than 40*l.* avoirdupois pound.

If, however, little had been done in rendering this singular substance generally useful, it is amusing to observe how much was hoped for. The following paper, given by Dr. Anderson in the *Bee*, of March 23, 1791, shows, both by the minuteness of description thought necessary, and the extravagance of the hopes avowed, how little was then really known on the subject:—

"The substance which forms the object of our present disquisition is called *Caoutchouc*, by the natives of the country where it is spontaneously produced. It is denominated elastic gum, or elastic resin, by philosophers in Europe; but it is now known in the shops by the name of Indian-rubber; a substance that few of our readers are not acquainted with. It is a firm, tough, pliable substance, greatly resembling some kinds of leather; but it possesses a degree of elasticity that cannot be equalled by any known substance in nature. It admits of being stretched out in every direction to an astonishing degree; and when the distending power is removed, it recovers its former shape and appearance. It neither can be dissolved in water, in ardent spirits, in acids, nor alkaline liquors, in the ordinary state of our atmosphere. Oils, in some measure, act upon it; but the vitriolic ether is the only complete solvent of it that is as yet known. It is inflammable, and burns with a clear steady flame, emitting then a slight smell, not at all disagreeable. When exposed to a cold air, it is more hard and rigid than under a milder temperature; but it neither becomes fluid, nor loses its elasticity, till it be exposed to a much more intense degree of heat than is ever experienced in any climate on the globe. It may, however, be melted by a very intense degree of heat; and then it assumes a thick viscid appearance, like some kinds of semi-fluid oils. And having once been reduced to that state, it cannot be again made to acquire its former consistence or elasticity.

"This substance is now well known to be the inspissated juice of a tree. The natives in those regions where this tree abounds, extract the juice by making longitudinal incisions in the bark. It bleeds freely, and the juice, in a thick state of semi-fluidity, is collected into vessels placed to receive it at the bottom of the tree. It is then, by means of a brush, spread upon moulds prepared for the purpose, and suffered to dry in the sun, or before a fire, which, by evaporating the moisture, soon brings it to the state in which it is sent over to us. By adding successive layers above each other, it may be brought to any degree of thickness wanted; and by varying the form of the mould, it may be made to assume to any shape or appearance you incline; which shape, as has been said, it will ever afterwards retain, if no distending force be applied to alter it.

"From this simple detail of facts, it is easy to see, that the uses to which this substance might be applied in arts and manufactures are innumerable, and such as can be effected by no other known substance in nature. Yet so blind have mankind hitherto been to these advantages, that no attempts have been made in any accessible region where extensive manufactures could be established, either to cultivate the tree that produces it, or to induce the natives to send the juice in its fluid state to Europe, where it could be properly manufactured. All that has been done is, to suffer the natives to mould it into the form of a small kind of bottles, which is found to answer some purpose among themselves; and these, when brought to Europe, are applied to scarcely any other use than being cut to pieces for

the purpose of effacing marks made upon paper by a black lead pencil, or that of idly amusing children by stretching it out, and observing how perfectly it again recovers its pristine form, after having been distended to a great length in any direction. We amuse ourselves with the phenomena without profiting by it, as children used to be amused with the attraction of amber, before the phenomena of electricity were explained.

"It is now time that we should begin to make some use of this very valuable substance, which, probably, a hundred years hence, will administer in a variety of ways to the accommodation of our descendants. With that view, I shall here venture to point out a few of the useful purposes it may be made to answer; not doubting but the invention of men, whenever they can get the materials in their hands in abundance, will discover a variety of other important purposes it will serve, that have not as yet been dreamt of.

"1st. This substance so much resembles leather, that it naturally occurs, that it might be employed for the purpose of making boots. These would not only admit of being made of the neatest shape that could be imagined, but also, by being impervious to water, or the other corrosive liquors abovenamed, would be sufficient to protect men from wet, though standing in water. For seamen, fishermen, and others, who are by their business obliged to wade in water, such boots would be of the greatest utility. The feet and legs might thus be protected from the action of even acids or alkaline subtances themselves, wherever that should become necessary.

"2nd. *Gloves* of this subtance would be so soft and pliable, as to allow the fingers perfect freedom of action; and in those kinds of businesses, that require artificers to put their hands among acids or corrosive liquors, they may become highly convenient.

"3rd. *Caps.*—The uses that might be made of this substance for defending the head from wet are infinitely various, and might prove highly beneficial. A thin covering of this substance might be made for travelling hats, which, without adding any sensible weight, would be perfectly impermeable by wet of any kind. Every other kind of covering for the head might be thus rendered water-tight, merely by giving them a slight coat of caoutchouc, which would in no sensible degree alter their other qualities. Bathing-caps, in particular, could thus be made extremely commodious, and at a small expense. This could be done, by covering with a coat of caoutchouc an elastic stocking-cap, which, merely by being pulled tight over the head, would embrace every part of it all round, so as to prevent the entrance of water. The stocking and the covering being equally elastic, they would contract and expand together without any sort of difficulty.

"4th. *Umbrellas.*—Neck-pieces of silk, or other materials, cloaks or travelling coats of any sort, that should be judged proper, could thus be rendered perfectly water-tight, without destroying their pliability in the smallest degree. It would only be necessary to cover them with a coat of this soft varnish after they were made, so as to close up the seams. Buckets, too, all of canvas, or any other cheap substance, might be made water-tight and incorruptible, by merely covering them with this matter. Vessels also for holding water and other liquors, that would not be liable to breakage, might thus be made of any size or shape at a small expense. In short, it would take too much room to attempt to enumerate half the uses that might be made of it in the household way.

"5th. In the army and navy, its uses would be still more numerous and important. *Tents* are an article of very great expense: the canvas for them must be of the very best quality and closest texture; and, after all, they are seldom proof against continued rain. At any rate, the vicissitudes of weather soon rot the canvas, and make a new supply in a short time be necessary. Were these tents covered with a coat of this substance, the entrance of rain through it would not only be altogether precluded, but also, the very wetting of the canvas itself would be prevented, and, of course, its durability be augmented to a tenfold degree. On the same principle, the sails of a ship would not only be made to hold the wind in the most complete manner, but by being covered by a thin coat of it on both sides, the sail-cloth itself could never be wetted, and, of course, its durability be augmented, while its flexibility would not be diminished. Other uses to which it could be applied in the army and navy, are so numerous as not to admit of being here specified. It is only necessary barely to mention, that on a military expedition, to have a vessel capable of containing fluids, which, when empty, admits of being wrapped up like a handkerchief and put into the pocket, might, on some occasions, be of inestimable value; and the same at sea.

"6th. *Aerostation* is now nearly at stand; but it is wonderful that no one ever perceived the use that might have been made of this substance for that purpose. No kind of silk, or other light substance, could ever be found, that possessed the smallest degree

of elasticity; by consequence, when they ascended into the higher regions, the expansion of the gas was in danger of bursting the globe; it was therefore necessary to leave it open below to guard against that accident. A globe of caoutchouc would have possessed the quality here wanted; it would have expanded as the circumstances of the case required; and while it was perfectly tight, to prevent the involuntary escape of the smallest quantity, it would have adapted itself in size to every variation of circumstances. It is true, the retentive power of this substance, when very thin, has never yet been ascertained by experience; but there is reason to believe it is very great.

"7th. As this substance is inflammable, and burns with a bright flame without requiring any wick, it might be employed perhaps with great economy as torches or flambeaux. Solid balls have also been made of it, that are light, and of an amazing degree of elasticity; but what useful purpose could be made of these, does not at present appear. It might also be moulded into the form of riding-whips, and would probably answer that purpose admirably well; and after they were wore out, they might be employed as torches.

"8th. As a material for chirurgical purposes, it might be employed on many occasions. *Catheters* have already been made of it, after having been dissolved in ether, that have been found to answer the purpose wanted, and to occasion much less irritation in the parts than those of any other sort that have yet been tried; but the great price, when thus manufactured, prevents them from coming into general use. The little bottles, when applied to the breasts of women distressed with sore nipples, can be so managed, as to occasion a more gentle suction than can be effected any other way, and have therefore afforded very great relief. In short, the variety of uses to which they might be applied, as bags for injecting or for sucking, are too numerous, to admit of being here so much as pointed at.

"9th. *Elastic Springs.*—In all cases where a spring is wanted to act by its *contractile* power, no substance can be conceived more proper than that of which we now speak, especially in cold climates; and there are innumerable cases in which it might be employed in this manner with the happiest effect, in various kinds of machinery.

"10th. It is many years since Dr. Bergius at Stockholm, made some experiments on this substance in Papin's digester. By subjecting it in that way to an intense degree of heat, it is said to have been converted into a hard, elastic, horn-like substance. I have not heard that these experiments have been repeated; but if upon further trial this shall be found to be invariably the result, it would extend the utility of this substance far beyond the limits we have hitherto thought of; but in the state of uncertainty that at present prevails on that head, it would be improper to say more.

"I might go on at this rate for many pages together, pointing out various other uses to which it might be applied; but I shall content myself with specifying one other only.

"Geographical globes are at present an article of great expense, especially when of such a size as to admit of exhibiting a tolerable view of the earth's surface. These could be made of caoutchouc of any size required, at a very moderate expense. The savages of America, whom our philosophers represent as destitute of every mental endowment, will teach us the way of proceeding.

"The little bottles we import from thence, are formed upon moulds of clay dried in the sun. When the caoutchouc has hardened on the surface by the process already described, a little water is introduced at the mouth of the bottle, which gradually softens the clay, and in time allows it to be washed entirely out of it. A globe of clay might be easily moulded of any dimensions required, leaving at one of the poles a small protuberance for a little neck. This ball, when dry, might be covered with caoutchouc till it acquired the thickness required; and for the purpose here wanted, this might be very thin. The clay might then be washed out, so as to leave it empty. The remainder of the process might be here described, were I not afraid of encroaching too much on the patience of the reader.

"It now only remains, I should give the reader some notices concerning the tree that produces this singular substance.

"In no one instance that I know has the inattention of mankind to useful improvements been more conspicuous, than with respect to the object of our present discussion. It is not much less than sixty years since Mr. de la Condamine first made known to Europeans this singular substance, which possesses qualities that obviously render it one of the most useful bodies that hath ever come to the knowledge of man for many important purposes in life; yet the culture of the plant which affords it, has been, till this moment, entirely neglected by every European nation; nor do I believe, that ever a single seed of it was planted by one person in the universe."

Then follows a botanical account of the tree Hevea, from which the juice is obtained.

While the processes suggested in this paper are in some instances not very dissimilar to those since employed, in others they are totally unlike, and have been found utterly useless. The principal scheme was to cover woven fabrics with a film of caoutchouc. To this there were insuperable objections. No substance was then known, which, while capable of dissolving solid caoutchouc, was cheap enough for popular use. Besides, when managed by any process then known, it was left on the surface of the cloth in too viscid and adhesive a state to be at all serviceable. The only hope, therefore, was, that the juice might be obtained and applied in its native fluid state, the solid caoutchouc settling upon, and adhering to, the substance to be coated. With how little success this attempt was attended will be seen hereafter.

It was, however, in the same year (1791) that the first successful trial was made; but it was conducted on a different principle, and its results, though useful, were very limited. The following extract shows the mode of operation adopted by Mr. Grossart, as explained by him to the Academy of Dijon:—

" It has been remarked, that if shreds of these bottles fresh cut down be pressed very close upon each other, they may be made to adhere so closely as to appear one piece. This operation is facilitated if the caoutchouc be softened in warm water. Upon this principle he thus proceeds:—After having provided a mould of a proper size for the open of the tube intended, he slices down the caoutchouc into thin shreds, puts these into boiling water; after they have remained there for some time to soften, he takes out these shreds, and rolls them tightly on the mould, taking care to make the edges overlap each other; one shred is applied after another, till the mould is all covered to the thickness wanted, then a ribbon is bound as tightly as possible over the whole, and above that it is still more closely bound by a tire of packthread, laid close to each other over the whole surface. In this state it is allowed to remain for some days, when the packthread is unbound, and the ribbon taken off. The mould may then be easily drawn out after dipping it a few minutes in hot water, and the tube is formed."—*Mechanics' Magazine.*

(To be continued.)

ATMOSPHERIC-ENGINE AND SELF-REGISTERING BAROMETER.

The following is the description of a machine which may be called an atmospheric-engine, the motion and effect being produced through the variations in the pressure of the atmosphere. The power of the engine, as will be seen, is rather circumscribed, but still it is capable of being made to act with any assigned force through a small space. It might, perhaps, be useful in any operation requiring other machinery to be set in motion at a point of time when the barometer indicated a particular state of the atmosphere.

It is easily convertible into a self-registering barometer.

That part of the accompanying figure included between (0) and the number 30,5, represents the section of a tube, closed at top and open below. It is attached to the end of a chain, by which it is suspended, and which passes over a pulley, the other end being fastened to a fuzee and counterpoise, or a fuzee and spring-barrel. Either will be practicable; but we must conceive it to be so suspended, that it will descend through equal spaces, when it becomes charged with equal weights. The lower (open) end is to be placed in a fixed vessel, represented in the figure. This vessel contains mercury, the surface of which rises to (0), which is above the end of the tube, when the latter is at its highest point of suspension; it is so represented in the figure. The numbers indicate the length of the tube, in inches, between the points opposite to which they are placed; and, therefore, the whole space included between (0) and 30·5 will be 59·8.

The figure is drawn to represent the tube at the height at which it would be suspended when the column of mercury it is supposed to contain stands at 29·3, being just so many inches above (0) the surface of the mercury in which the end is immersed; the space in the tube above 29·3 being then a Torricellian vacuum. The surface of the mercury in the lower vessel is prevented from *rising* or *falling* from its place at (0) by means of a floating-cistern containing mercury, and placed in an adjoining vessel, not represented in the figure, the communication being maintained by means of a fixed syphon. The

heights of the columns 29·3 and 30·5 are assumed, as limiting the space in which the greatest number of variations occur in the barometer throughout the year.

To regulate the countervailing force, and calculate the power of the engine; first, the countervailing force is to be adjusted to balance the tube in the place represented in the figure, the weight given being the small column of mercury standing 29·3 inches above the surface at (0) added to that of the tube; then supposing that the pressure of the atmosphere has increased so as to require the column to rise from 29·3 to 30·50 inches; by this rise the equilibrium just effected will be destroyed, and the tube will descend. Suppose it continues to do so until the point marked 29·3 comes on a level with the surface at (0); at this time the enlarged part of the tube will be filled to 30·5 with a cylinder of mercury, whilst the smaller part will have descended into the portion of the lower vessel made to receive it. Here, then, is given the weight, being that of the cylinder of mercury in the enlarged part of the tube, 30·5 inches long, added to the weight of the tube, and the space through which it has descended (29·3 inches), to calculate the countervailing force at this terminating point.

A twelfth of 29·3 inches will be, according to the supposition, the space through which the tube will descend after the accession of each tenth of an inch to the head of the column; and a twelfth of cylinder standing 30·5 inches in the enlarged part of the tube, will be the increase of weight to be counterbalanced after each such accession—the difference of the columns (30·5—29·3 = 1·2) containing twelve such accessions.

Allowing the head of the column (1·2 inch) to weigh, according to the diameter of the enlarged part of the tube, 29 ounces or pounds, when the tube has descended 1 inch, it will press on any obstacle, or the chain will turn the pulley, with a force of 28 ounces or pounds; when it has descended 2 inches, it will act with a force equal to 27 ounces or pounds; and so on decreasing *one* in effect for each inch it descends. It is easy, therefore, to assign the space through which the engine will exert any force within the premised limit.

If, while the pressure of the atmosphere require that the column should rise from 29·3 to 30·5 inches above the surface of the mercury at the foot of the tube, the syphon be removed, and the open end of the tube stopped for an instant, until the surface surrounding the foot can be depressed by any means, to a distance of 1·2 inch below (0), and then the stopping taken away, the condition (that the column shall stand 30·5 inches) being thus satisfied, no further rise will take place in the column. The accession of weight gained, in this case by the column, will be but that of a cylinder 1·2 inch long in the small end of the tube, and, consequently, the descent will be very trifling.

Supposing the head of the column to *rise* exactly at the same rate that the surface below *descends* (as is the case in the tube of the common wheel-barometer), the conditions, imposed by atmospheric pressure, will be satisfied, when half as much mercury flows into the tube as would have risen into it had the surface at the foot remained stationary, and the power of the engine will be proportionally curtailed; but the cylinder in the enlarged part of the tube, though thus shortened, will be subject to change with the variations of the column, in the same manner as that which has been described as filling the whole tube from 29·3 to 30·5.

Heretofore, to facilitate description, the cylinder of mercury in the enlarged part of the tube has been supposed to receive *equal* additions, at the times, the head of the column received equal additions to its height. It is not, however, necessary that the additions to the cylinder should be equal among themselves, but only that the *sum* of the series of them, added to the sum of the contemporary accessions to the head of the column, should *together* equal 30·5 inches; or equal to the length of the longest cylinder in the enlarged part of the tube, *due* to the pressure of the atmosphere and subject to the countervailing force. The engine is also capable of acting without the aid of a floating-cistern; but certain limits must be regarded, which it was the object of the foregoing remarks to notice.

If the counterbalance be effected by means of a weight and fuzee, the fuzee may be cut to the form of almost any spiral curve, and yet be within the requisite conditions; still, however, some of these will answer the purpose better than others.

A self-registering barometer is easily constructed on these principles; for if the tube (which for this purpose should be, at least the upper part, of glass) be suspended immediately from a spring, or system of springs, the descent of which may be found by experiment, and the points marked on a scale, the tube being loaded for the purpose, a moveable index may be made to show the greatest and least range of the tube within any given time.

The scale along which the tube will range will be equal in length to the greatest descent of the tube, that is, in the foregoing example 29.3 inches. A couple of small weights suspended on the face of the scale by fine silken threads passing over two delicate pulleys, and counterpoised, will mark the highest and lowest position of an index fixed to the tube; and which may be made to raise one weight up, or push the other down, as it passes over the scale. If a floating-cistern be used, the scale of a common barometer may be also fixed at the head of the column; this is a great advantage, and serves as a test of the accuracy of the instrument.

The floating-cistern alluded to is provided to receive the mercury, or furnish it back again, without raising or depressing the surface of the mercury at the foot of the tube, when the latter rises or descends, and, of course, empties or fills. It is only a vessel set on a stem, or float, which swims in an-

other vessel containing mercury. The stem is calculated to sink exactly as much as the surface of the fluid flowing into the cistern *rises above its bottom.* It (the stem) is cylindrical or prismatic, according to the form of the cistern, and must contain as many cubic inches as the measure of the quantity of fluid which the cistern is to hold. In length it must be equal to the *sum* of the height of the fluid above the bottom of the cistern, added to the space through which the surface of the mercury rises in which it (the stem) swims during the filling of the cistern. The stem is itself set upon a float, which will support it and the *empty* cistern just at the surface of the mercury it floats in. The principle is, in fact, the same as that described in the account of the self-registering barometer given in No. 403 of the *Mechanics' Magazine* for April, 1831. It is, however, scarcely possible to procure, by ordinary means, a glass tube 20 inches or 2 feet long of a regular form; therefore, when one is used as a cistern, a further adjustment of the stem becomes necessary, as described in that account. For the present purpose, the cistern need be only a few inches deep; and as it may be made of wood or iron, it can be had of a regular form.

It is hardly necessary to say, that in making calculations for the barometer the columns would be assumed at 28 and 31 instead of 29·3 and 30·5 inches.

One sort of counterpoise may be worth noticing. It consists of a cylindrical vessel closed at one end, and of such dimensions (adapting it to the foregoing example), that 29·3 inches in length of the inside shall contain in measure an equal number of cubic inches as 30·5 inches of the enlarged part of the tube. This vessel is to be attached to the other end of the chain by which the the tube is suspended (by the closed end), the chain being merely passed over a barrel or pulley; it is then filled with mercury, and immersed, open part downward, in a vessel of the same fluid, and sunk by means of weights until the closed end comes on a level with the surface; the column in the tube standing at 29·3, as it is represented in the figure. If now the column in the tube rise to 30·5, the equilibrium being destroyed, it will descend through a space of 29·3 inches, at the same time raising the vessel at the other end of the chain, with a column of mercury in the inside of it, supported by the pressure of the atmosphere, to a height equal to the space through which it descended, when the equilibrium will be restored.

If the engine were made of dimensions suited to water, instead of mercury, a column of 24 feet might be depended on in all states of the atmosphere. The head, whatever its dimensions, would work with half its weight through a space of 12 feet; and if the foot of the tube were placed in an intermittent well, or in a tide, which would rise and fall a couple of feet, the engine would give a double stroke each time such rise and fall occurred; the counterpoise working as well as the weight in the tube.

W. M. G.

London, Feb, 10, 1836.

[*Mechanics' Magazine.*

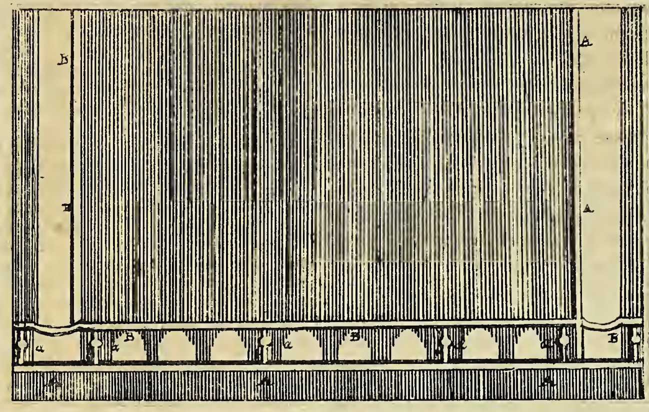
RAILWAY TRANSIT.—It would require 12 stage coaches, carrying fifteen passengers each, and 1200 horses to take 180 passengers 240 miles in twenty-four hours, at the rate of ten miles an hour. One locomotive steam-engine will take that number, and go two trips in the same time, consequently, will do the work of 2400 horses! Again, it would require thirty mail coaches (six passengers each), and 3000 horses, to take 180 passengers and mail, 240 miles in twenty-four hours, at the rate of ten miles an hour. One locomotive steam-engine will take that number, aad go two trips in the same time, consequently, will do the work of 6000 horses!—*T. M. Hackney.—Ibid.*

EXTENSIBILITY OF GOLD, SILVER, AND PLATINA.—The hundred-thousandth part of a grain of gold may be seen by the naked eye; and a cube of gold whose side is but the hundredth part of an inch, has 2,433,000,000 of visible parts. A cylinder of silver covered with gold leaf may be drawn out 350 miles long, and yet the gold will cover it. Gold leaf can be reduced to the three hundred thousandth part of an inch; and gilding to the millionth. Silver leaf can be reduced to the hundred and seventy thousandth. The specific gravities are 193 to 105. Lace-gilding is the millionth of an inch thick; gold leaf the two hundred thousandth. Platina wire may be the fifty thousandth of an inch; 500 inches of gold-wire has been drawn from a grain. Tinfoil is the one thousandth of an inch, that is, 200 gold leaves are only equal in thickness to one of tin-foil. One grain of gold will cover 7½ inches each way, or 52 square inches, or be 1,500 times thinner than writing-paper, that is, a sheet of writing-paper would be 1,500 leaves.—*Ibid.*

A 200-SCAVENGER POWER.—M. Bernel, an Engineer at Lyons, has invented a machine, which, worked by one horse, collects and throws into a cart, in a given time. as much mud as could be collected by 200 scavengers.—*Ibid.*

IMPORTANT TO BAKERS.—A mechanical kneading trough has lately been invented by a baker of the name of M. Fontaine, at Paris, for which he has obtained a patent from the French Government. The chief advantages derived from this new invention are, that from 30 to 800lbs. of dough can be kneaded in the small space of 15 minutes, with the labour of only one man, and that without the least fatigue. It also causes the dough to be much better kneaded, consequently the bread is much better made than by the process usually adopted. The invention is the fruit of long experience.—*Ibid.*

SAFETY METHOD OF LIGHTING COAL-MINES. BY DAVID BOOTH, ESQ.



The above engraving represents a vertical section of a coal-mine, with its down-cast and upcast shafts.

Within the downcast-shaft is fixed the feeding-main, which is a pipe leading from the surface to the bottom of the pit, and thence proceeding under and along the pavement to any distance, and in any direction that may be requisite: its progress is here marked by the letters A A A, &c. This pipe (having another inserted) is for the purpose of carrying atmospheric air and gas to the several burners *a a a*, &c.

B B B B B is the evacuating-main for conveying the products of the combustion, which pass along until they reach the upcast-shaft, when they ascend to the mouth of the pit (and higher if necessary), where they are dispersed in the atmosphere. This main is carried along the roof of the pit, as high as it will allow.

The supply of air and gas to the burners may easily be regulated by stop-cocks, and the lighting of the lamps may be accomplished, without exposure, by means of one or other of the various modes of producing instantaneous light called Lucifers, Eupyrions, &c., acted upon by a wire passing through an air-tight aperture. Each lamp may be separately extinguished and unscrewed from the mains, so as to be cleansed when necessary, while the others are left burning.

For working in narrow excavations, a moveable lamp may be supplied with air from the nearest part of the feeding-main, by means of a flexible tube (similar to that of a beer-engine) furnished with screws and stop-cocks, so as to be lengthened by additional pieces, or shifted to other stations at pleasure. From the required length and flexibility of this air-tube, it might be difficult to insert a gas-pipe and probably oil only could be burnt. This distance, too, to which the lamp would, in some cases, need to be carried, might render it impracticable to convey the produce of the combustion to the evacuating main; but, nevertheless, it is presumed that the lamp might be made perfectly safe:—in the first place, by having the chimney of sufficient length to prevent the possible egress of the flame; and, secondly, providing that the heated vapour, before mingling with the atmosphere of the mine, should have to pass through small holes, similar to those in the rose of a watering-pot, and which holes might be lengthened into tubes, or even passed through water if found necessary. The inflammable gas of mines, if it enter the Davy-lamp, must be carried along with the current that supplies the flame, and would not readily pass into this insulated lamp, the current of which would always press outwards.

The proposer is aware that the preceding is merely a sketch of a general principle, which will require to be modified according to particular circumstances. He acknowledges, too, that, in many cases, its adoption would lead to much expense; but, as a counterpart to this, may be placed the annual saving, from premature destruction, of a great number of valuable human lives.

David Booth.

Charlotte-street, Bloomsbury, Feb. 8, 1836.

[*Mechanics' Magazine.*

We have just been favored with the loan of a new periodical, the Magazine of Popular Science and Journal of the Useful Arts. The intention of this work is the exclusion of all elaborate original memoirs of scientific researches, and in their place to condense into brief essays, or abstracts, such accounts of the progress of discovery on the several branches of physical inquiry as to place in a connected point of view the labours of different individuals engaged in these enquiries.

The two first numbers for February and March, 1836, contain some interesting articles, from which we glean the following.

GALLERY OF PRACTICAL SCIENCE.

The Gallery of Practical Science was projected in the Autumn of 1831, by a few individuals desirous to promote the intercourse between the cultivators of abstract Science, and persons engaged in its practical application; to illustrate scientific subjects in a manner at once interesting and instructive; and to afford to discoverers in philosophy, inventors, improvers of inventions, manufacturers, and individuals possessing interesting objects of virtue, the opportunity to bring before the public their discoveries or works of art, in an attractive and inexpensive manner.

The finishing and fitting-up of the premises occupied the period till the 4th of June, 1832, when the rooms were opened in the evening to a numerous company invited for the occasion; on the following morning the gallery was opened to the public. The number of visitors contributing to the support of the institution, was found gradually to augment, and the original proprietors were thereby encouraged to extend the basis of the establishment; and the most secure means of effecting that desideratum appeared to be a Royal Charter of Incorporation.

The late Thomas Telford, Esq., the most eminent engineer of his age—whose name will endure longer than even the numerous works of his construction, which have improved whilst they adorn our country,—and Francis Giles, Esq., civil-engineer, were the first individuals to join the orginal projectors; and in answer to their united petition, his Majesty was graciously pleased to grant the charter, which incorporates the shareholders under the title of "The Society for the Illustration and Encouragement of Practical Science."

Authority is given by the charter to divide the capital of 20,000*l.*—consisting of 4,000*l.* in money, and 16,000*l.* invested in the premises and philosophical apparatus placed therein—into 400 shares of 50*l.* each. It also confers the privilege of raising a further capital to the extent of 20,000*l.*, in similar shares, should the proprietors, at a general meeting, specially convened for that purpose, so determine.

All contracts are to be made under the corporate seal of the society, which, with the properties and affairs of the institution, is entrusted to the management of a council, consisting of not fewer than four, nor more than fifteen of the proprietors. The accounts are required to be made up and laid before the proprietors, at least once in every year, when dividends of the profits may be declared.

It must be obvious, that where the arduous task is undertaken of accommodating a public exhibition like the present to the various tastes of a mixed assemblage, there will, of necessity, exist some points which shall be highly attractive to one class of visitors, whilst they will be regarded as comparatively unimportant by others. Thus the Persian rope-dancer, which, with its fairy-like music and elegant movements, is a never-failing source of admiration to the young, may, by others, be held in light estimation; unless, indeed, a love of science shall lead them to examine and inquire into its ingenious and elaborate mechanism. So also with the automaton juggler; there are, however, some other marked features, some central points, as it were, of attraction, deserving especial notice; and to these we shall briefly advert.

We will commence with the series of Magnets, which are prepared for the daily illustration of some of the appearances and effects of electro-magnetical and magneto-electrical phenomena. The *Electro-Magnet*, possessing neither Electricity nor Magnetism, until excited by a very small voltaic battery; it then instantly acquires an enormous power of suspension: on destroying its connexion with the battery, it becomes again unable to support a grain. Another of the same kind, and called the *Ferro-Electric Sphere*, arranged to show the true cause of the Earth's Magnetism. A third, is a *Self-acting Electro-Magnetic Machine;* in this also Electricity excites Magnetism, producing motion in a spindle, and by an ingenious contrivance, which effects an alternation in the poles, continues this motion, and gives out an uninterrupted succession of sparks and shocks for an indefinite period. The *Magneto-Electric Machine*,—in this combination Magnetism produces Electricity. This instrument was made in consequence of Professor Faraday's important discovery, that electricity could be obtained by means of magnetism; and was the actual one from which the first spark was first produced and seen in England. It now exhibits the spark most brilliantly and incessantly,—gives an intolerable shock,— decomposes water,—ignites and fuses platinum-wire, &c.

There is also an instrument which belongs to a department yet scarcely explored by scientific research, and one which we fear is too often passed unheeded; we allude to an apparatus for showing the Compressibility of Fluids by means of hydrostatic pressure which can be produced in this machine to the unprecedented amount of 30,000 lbs. to the square inch.

The celebrated Steam-Gun is too well known,—and the unceasing interest it excites, far too generally admitted to require any particular notice. We shall, therefore, merely observe, *en passant*, that a new barrel has lately been added, which increases the power and the precision of the instrument.

The unique engine for showing the Combustion of Steel, is also well worthy the attention both of the curious or the general observer; although the almost inconceivable velocity with which the wheel rotates, may, naturally, at the first moment, excite some alarm.

Amongst the philosophical apparatus possessed by the Society, may be mentioned a Lens or Burning-Glass of nearly four feet diameter. A Cal-oxi-hydrogen Microscope of great power and unrivalled splendour, constructed by Cary, with various consecutive improvements made under the superintendence of the Society; and a Laboratory—intended to facilitate the advance of science and practical knowledge.

The Society receive for exhibition—Models of Inventions—Works of Art and Specimens of Novel Manufacture, subject to immediate delivery in the event of sale, or return on demand; *free from any charge whatever to their depositors*. It also affords every facility for the practical demonstration of discoveries in Natural Philosophy, or of any new application of known principles to Mechanical Contrivances; reserving only to the Council, the right of determining whether the productions offered are suitable to the Institution.

SIMPLE AND EFFECTUAL MODE OF DEFECTING ERRORS IN LEVELLING OBSERVATIONS.

In the best modern levelling-staves, as for instance, those for which a Telford medal was awarded to Mr. Gravatt, C. E., last year, by the Institution of Civil Engineers, the observation is at once read off by the surveyor, instead of being reported to him by the assistant; a saving of time, and a diminution of the sources of error, are the consequence. But still, if a surveyor, on the conclusion of his field-work, suspects an error, he has no other means of discovering the place of the error, or removing the suspicion, but re-commencing the survey and repeating part, probably the whole, of his observations. A very valuable suggestion has been made by Mr. Henry E. Scott, which, if adopted by a surveyor, would, almost to a certainty, enable him, by merely referring to his field-book, and without the repetition of a single observation, to detect the place of the error, and correct it; or, in case of there being none, to restore his confidence in his observations and final result. Mr. Scott's practice is to have the front side of his levelling-staff graduated from the bottom as usual, and painted in black and white; but in addition, he graduates the rear-side of his staff, and paints it in *red* and white. This red graduation is in the sub-divisions the same as the front one, but the position and numbering of the principal divisions are different: the first principal red division being made at 0·75 ft. from the lower end of the staff, and numbered III. the next above, IV., and so on. Both sides of the staff are to be read off at each observation; and it is evident, that two very different heights of each observed point will be recorded; that from the red side being constantly 2·25 ft. higher than that from the black or the true one. A difference so wide, that the memory can never act disadvantageously in reading off the quantities on the two sides. An error in the levels can, by this mode of registering, be detected by a single glance; for the surveyor has simply to ascertain the place where any two observations of the same point have not the regulated difference. If no case of this kind occurs, there arises a feeling of confidence in the accuracy of the whole level-survey, which can scarcely be shaken.

ON BORED WELLS.

This convenient, we may say elegant, method of obtaining good water from great depths, without the labour of lifting it, is spreading extensively in France, principally owing to the enlightened and patriotic exertions of MM. Arago and Hericart de Thury. The first, by his writings on the subject, and his successive notices of the works as they are executed, excites and keeps alive the attention of the whole French nation.

For the same purpose, with regard to our own country, we shall, at all times, be gratified by receiving and publishing, correct and detailed accounts of Bored Wells, executed in England, &c. Cases of supposed failure in these attempts, where all the circumstances are known, would be as acceptable as those of success. Hints might be suggested for proceeding again with a prospect of arriving at the desired object; or, if this is hopeless, the facts might be recorded and useless expenditure prevented in future similar cases. In preparing the accounts, attention should always be paid to the kind of strata passed through, their thickness, &c. The locality of the well should be accurately described, its contiguity to river, mountain, sea, lake, &c. or the contrary. The waters of infiltration, (land-springs, &c.,) should be noted; and the supply, qualities, temperature, and permanent elevation of the water finally obtained, should be very carefully observed and described.

Among the more recent instances of success in well-boring in France is one not far from the bank of a river, in a meadow belonging to the Château de Cangé, about three miles from Tours. The water was found at 425 feet deep, and the supply is about 560 imperial gallons per minute. At Elbeuf, two wells, contiguous to each other and to the river Seine, have been bored to nearly 500 feet. They are remarkable for the volume, purity, and high temperature (61º Fahr.) of their waters. In twenty-four hours after a storm, or violent rain, one of these wells becomes troubled, and its water issues turbid with clay or sand, precisely like that of the

Seine after heavy rains. As the bore of this well proceeded, several lots of very minute eels floated out from it: many of them were caught alive and sent to Paris. A M. Dieu has lately announced to the French academy, that he is occupied in endeavouring to use steam-power as an agent in this art.

In a well lately bored in one of the abattoirs (public slaughter-houses) of Paris, the depths and thicknesses of the strata were carefully noted; and M. Arago himself examined the temperature of the water obtained: at 815 feet deep, he found it to be 68½° Fahr. The engineer was prepared to have gone down to 1300 feet, but having pierced through the bed of chalk under which was found the water at Elbeuf, he desisted at the depth of 815 feet. From this depth the water rose to within 16⅔ feet of the surface.

If now we look on the other side of the picture, and regard the failures in France, we shall find a case the most remarkable for the extent of area over which unsuccessful attempts have been made, in the valley of the Garonne. From Toulouse to Bordeaux little hope is now entertained of profiting by wells of this kind. At Toulouse, the bore was carried down about 780 feet, being 282 feet below the level of the Mediterranean, and abandoned after a cost of above 1100*l*. At Agen, at the depth of 400 feet, a series of calcareous earths, &c., similar to what had already been passed, again commenced, and the undertaker gave it up in despair. In Bordeaux, they bored through strata, &c., very like what had been met with at Toulouse, and not having met with water at 670 feet, it was deemed useless to proceed. Four other bores in the neighbouring department of La Gironde, were also unsuccessful; in one only did water appear. These repeated failures have naturally indisposed the inhabitants of this quarter of France to further attempts. A considerable addition to the geological knowledge of this part of the kingdom has, however, been obtained; and among the facts collected by M. Boisgeraud, there is one result relating to the temperature of the earth, from 30 feet below the surface down to 340 feet, which deserves to be recorded. The mean of seven observations, each of twenty-four hours' duration, was found to be 2¾° Fahr. for each 100 feet of depth: an increase which accords with that which is generally admitted.

The first bored well executed in the empire of Russia, was recently and successfully completed at Riga.

CURVILINEAR DIRECTION OF WINDS.

Careful and continued observations, contained in the annual reports furnished by the several academies in the state of New York, to the Regents of the University, appear to demonstrate the fallacy of the notion commonly entertained, that winds are generally rectilinear in their progress, and blow for the most part in right lines over extensive portions of the earth's surface; an error which appears to remain undisturbed in the minds of most meteorologists.

TEMPERATURE OF CANTON AND MACAO.

Mr. Meyen, for some time a resident at Canton and Macao, states as the result of his own observations, and those of other residents during very considerable periods, that the mean temperature of Canton is 71½° Fahr. and that of Macao 72¾° Fahr. It will facilitate accurate comparison to remark that the mean temperature of London, as stated by Professor Daniell, is 49½° Fahr.

FILTRATION AND COOLING OF LIGHT.

M. Melloni, in examining the correctness of his opinion, that light and radiant heat were produced by different causes, and that there was therefore a possibility of separating them from each other when combined, has succeeded in accomplishing this remarkable experiment. By a process extremely simple, he separates light from radiant heat, whether proceeding from ordinary fires or from the sun. His mode is this:—The radiation from a luminous body is passed through a system of diaphanous bodies,—these absorb all the radiant heat, and extinguish but a very few of the luminous rays. The pure light emerging from such a system is found not to affect the most delicate thermoscope, even when concentrated by lenses to a brilliancy equal to that of solar light. The substances hitherto employed in this heat-absorbing system, are water, and a peculiar kind of green glass, coloured by oxide of copper. The cooled and filtered light, as it may be termed, is decidedly yellow, with a tint of bluish-green.

VARIATION OF TEMPERATURE IN ROCKY STRATA.

Mr. W. Henwood conceives that he has satisfactorily ascertained that a difference of 2°—3° Fahr. exists in the temperature of the schistose and granitic strata of Cornwall, when they are severally examined at the same depth. It is not stated to which the higher temperature belongs.

REFLECTED HEAT MEASURED.

The fact that heat is reflected more or less abundantly in proportion to the nature and polish of the surface upon which it impinges, was confirmed by the researches of Rumford and Leslie; but these philosophers did not proceed to ascertain the proportion, in each particular case, of the incident, to the reflected heat. It is easy to imagine a variety of cases, in which, the property of the reflection of heat being known, and also that its quantity was variable, it would be desirable, and often exceedingly useful, to be able to ascertain the amount which could be obtained from any particular body and surface. M. Melloni has recently shown, that by means of an apparatus, designed by him, the problem can be solved with great accuracy. Another instance in which the genius of M. Melloni, aided by the exquisite delicacy and sensibility of his apparatus, has detected and exhibited properties and proportions of this invisible and universal agent, which appeared a short time ago to lie far beyond the utmost reach of the powers of man.

FLOWERING OF A WEST INDIAN PLANT IN THE OPEN AIR.

At a Meeting of the Ashmolean Society of Oxford, on the 6th of November last, Dr. Daubeny exhibited a specimen of the *Bromelia pinguis*, a native of the West Indies, which flowered last autumn in the open air in the garden of Mr. Shirley, of Eatington Park, near Shipston-upon-Stour. This plant has rarely blossomed in Europe even under glass, although a drawing of it in flower is given in the *Hortus Elthamensis*; and the individual plant alluded to had been tried first in the pinery, and afterwards in the greenhouse, but had never put forth flowers, till it was taken out of doors, when it flowered, though the petals never properly expanded.

PHOSPHORIC LIGHT EMITTED BY FLOWERS.

At the same meeting, a communication was also read by him respecting an electrical phenomenon, which occurred in the garden of the Duke of Buckingham, at Stowe. On the evening of Friday, the 4th of September, 1835, during a storm of thunder and lightning, accompanied by heavy rain, the leaves of the flower called *Œnothera macrocarpa*, a bed of which is in the garden, immediately opposite the windows of the manuscript library at Stowe, were observed to be brilliantly illuminated by phosphoric light. During the intervals of the flashes of lightning, the night was exceedingly dark, and nothing else could be distinguished in the gloom except the bright light upon the leaves of these flowers. The luminous appearance continued uninterruptedly for a considerable length of time: it did not appear to resemble any electric effect: and the opinion which seemed most probable was, that the plant, like many known instances, has a power of absorbing light, and giving it out under peculiar circumstances.

BEET-ROOT SUGAR.

The exertions making in France and throughout Germany to simplify the process of preparing sugar from the Beet are immense and unceasing. At the recent meeting of the German naturalists, at Bonn, the section of Agricultuie and Rural Economy was almost entirely occupied with papers and discussions on the subject. At Valenciennes, a manufacturer has succeeded in discovering a method of crystallizing the whole of the saccharine matter of the Beet without producing molasses in the process. Three sugar-houses there have adopted the new plan.

SOUTH COOLER THAN THE NORTH.

The attention of meteorologists is requested to the fact, that in the two last months of 1835, the depression of the thermometer was greater, and commenced sooner in the south, than in the north, of France. And also, that in the Puyde-Dôme, a department a little south of the centre of that country, it was not the north winds, but violent ones from the west and south, which produced the greatest cold.

ELEPHANTS, HAIL, &c., IN ABYSSINIA.

In Abyssinia, according to Herr Ruppell, elephants and monkeys do not fear to cross plains, some of which have an elevation of 8300 feet, and on which the temperature must be exceedingly low. In the same country it hails frequently, but never during storms. This fact renders the explanation of the formation of hail still more difficult, it having been supposed, up to the present time, that electricity played an important part in the process.

APPLICATION OF OPTICS TO CHEMISTRY.

M. Biot is occasionally developing to the Academy of Sciences his mathematical and experimental method of detecting mixtures and combinations, both definite and indefinite, which act upon polarized light, followed by its application to compounds of tartaric acid with water, alcohol, and pyroligneous acid.

VOLUNTARY INSTRUCTION OF THE PEOPLE.

One of the most pleasing features of the present state of things, is the interest which the higher and well-educated classes in many places are taking in the social improvement of those less favoured by fortune or circumstances. In Edinburgh, lectures are delivered nightly by gentlemen to thousands of people, on subjects of Physical and Moral Science. In one place, which contains an audience of two thousand persons, lectures, the admission to which is only a single penny, are delivered to the working classes, on Moral and Economical Science, or, in other words, on topics calculated to improve their mental faculties and condition in life. An analysis of these lectures is given in the *Edinburgh Chronicle* newspaper, weekly.

PRACTICAL IMPROVMENT IN LIGHT-HOUSE ILLUMINATION.

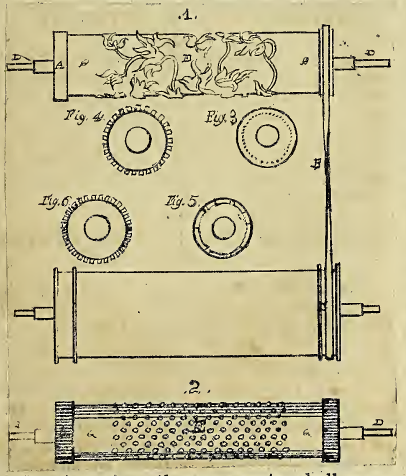
On the evening of the 1st of October last, a new light on the dioptric* principle of Fresnel, was exhibited on the Island of Inchkeith, in the Firth of Forth, in the place of the reflecting light which had been used there, and which was discontinued on the 30th of September. The new light is distinguished, like the old one, from others in the neighbourhood, by flashes, occurring once in a minute, but it is very far superior in brilliancy and magnitude. Its power, compared to its predecessor, is as $2\frac{1}{2}$ to 1. The cost of its maintenance is however greater, being as 17 to 7.

The light-house on the Isle of May, in the same neighbourhood, is in the course of an improvement of the same kind.

* In this principle, the light is *transmitted through* media as lenses, and not *reflected from* surfaces, as the British lights usually are.

SPECIFICATION OF THE PATENT GRANTED TO JOHN LOSH, OF 8, CRESCENT, IN THE CITY OF CARLISLE, GENTLEMAN, FOR AN IMPROVEMENT IN THE SURFACE OR PATTERN-ROLL OF THE MACHINES USED IN PRINTING CALICO AND OTHER GOODS, COMMONLY CALLED SURFACE PRINTING MACHINES, AND IN THE MODE OF WORKING THE SAID ROLLS.—

Sealed May 30, 1835.



To all to whom these presents shall come, &c. &c.,—*Now know ye*, that in compliance with the said proviso, I, the said John Losh, do hereby declare the nature of my said invention to consist in doing away with the toothed and pinion-wheel heretofore fixed on the axis of the pattern roll, and substituting therefore a driving band or belt passing over pulleys or elevated parts turned or formed on the end of the said roll, and of the exact diameter of the roll with the pattern upon it, thus constituting an improved roll, and a new mode of working the surface printing-machine separately, or attached to a cylinder printing machine, for the purpose of printing calico, linen, woollen, silk, paper, or other the like description of goods, and which improvement will remove the difficulty and loss that has hitherto attended the working of the surface printing-machine, a difficulty arising from the surface or pattern roll being propelled by a tooth and pinion-wheel fixed upon the axis of the pattern roll, and consequently the slightest variation in diameter between the pattern-roll and propelling-wheel, or mandril, varies the speed of the circumference of the printing-roll called the surface, and it therefore does not leave its own impression neat and plain as it ought to be, but is dragged along the face of the cloth and leaves instead a trailed mark upon the piece of goods intended to be printed.

And whereas, in further compliance with the said proviso, I, the said John Losh, do hereby describe the manner in which my said invention is to be performed by the following statement thereof, reference being had to the drawing annexed, and to the figures and letters marked thereon (that is to say):

The improved surface roll is made of wood bored through the centre from end to end to admit a cylinder of cast-iron or any other metal on which the roll should fit quite tight; if the wood when bored is not found to fit tight upon the cylinder fill up the space with glue or cement made of rosin, pitch, and Roman cement when hot, in the following proportions, namely: one pound of rosin, one pound of pitch, and a quarter of a pound of Roman cement, and run in between the wood and the cylinder, the glue or cement will then fill up the empty space and also bind the wood to the cylinder. The cylinder is cast with a flange inside each, and leaving only a sufficient hole in the centre through which to pass an iron spindle, which spindle forms the axis of the roll and is made fast to the flange at each end of the cylinder, which should be larger or smaller according to the diameter of the roll, so that when the roll is turned in the lathe to the size required there may only remain a small portion of wood upon the cylinder, but, at the same time, sufficient for the purpose required in forming the pattern upon it. At one or both ends the roll is left thicker, as shown at A, A, fig. 1, or when the pattern is a very distant one, instead of leaving the roll at each end thicker, drive in till on a level with the pattern; bars of copper or other metal, and only so many bars as the pattern forms rows from end to end of the roll so that the bars and the patterns may be in a line with each other, as shown at A, A, fig. 2. The circumference of these thick ends or elevated parts of the roll, whether left thicker in turning the wood of the roll, as shewn at fig. 1, or raised with bars of metal, as shewn at fig. 2, must in every case be precisely the same as the extreme circumference of the pattern upon the roll, as it is upon these elevated or thicker ends of the roll that the belt or belts traverse to give the necessary motion to the pattern. The pattern being formed upon the roll in the usual manner, with copper-pins, wood, &c., as required, which is smoothed upon the surface by being turned in a lathe, that part of the pattern roll over which the belt or belts pass, should also be carefully smoothed or turned down at the same time to exactly the same diameter. The surface roll is liable to become a little untrue, wear down, and also to dry in, by using it in a hot workshop, which cannot be prevented, and it is thus on the old plan rendered entirely useless, as it can, according to the old method of working the machine, be used only when exactly the same diameter as the mandril or principal carrying wheel, and when this once varies, from the causes hereinbefore mentioned, it cannot be rectified. All these difficulties and also some others are entirely obviated by my plan of propelling the surface or pattern roll by a belt or belts working upon the circumference of the said roll at either or both ends. The belt may be of

leather or other material of the ordinary kind and may be carried by the sieve roller, mandril, blanket, or principal carrying wheel. The advantage to be derived by my plan, is, that I can make the work completely perfect with a surface pattern roll of any circumference without regard to the size of the mandril or principal carrying wheel, and if a surface pattern has become untrue it may be put into the lathe and turned true, turning at the same time either or both ends of the pattern roll which the belt or belts pass over; the spoiled rolls, which were formerly a complete loss, may thus be put again into working order, and the large expense for new rolls is entirely saved; also by this mode of printing the immense expense of copper rolls used in cylinder printing may be saved, the improved surface-machine being rendered capable of executing the work equally well, and some styles and patterns much better, and at one fourth of the cost for rolls and patterns; this invention also enables me to work any number of rolls upon the surface-machine, each roll printing a separate colour at the same time, by which method a full chintz may be produced at one printing.

(To be continued.)

EXPERIMENTS ON INDIGO.

(Continued from page 192.)

The best radiators do not appear to belong to any particular class of bodies; litmus blue and Prussian blue are side by side, while sulphuret of lead, and the bi-sulphuret of tin, are fifteen numbers apart.

If the results be admitted as decisive of the radiating powers of the bodies used, they show that each substance has a specific power not depending upon chemical composition, nor upon colour. I do not claim to found such a conclusion upon the experiments; their object has been before stated, and if they shall prevent the introduction of an inference from an imperfect induction, as a law of science, the labour bestowed upon them will be amply recompensed.*

The action of sulphuric acid on indigo was very incorrectly described by the older chemists. In the year 1776, Bergman observed that when indigo in powder was sprinkled upon concentrated oil of vitriol, sulphurous vapours were evolved, clouds of a green colour formed in the liquor, and at the same time great heat produced. Berthollet, in his excellent work on Dyeing (Hamilton's translation, vol. ii. p. 66), considers the change which takes place to be caused by a species of combustion, the acid furnishing the indigo with oxygen. Dr. Bancroft conceived the solution to be oxygenated indigo in combination with sulphuric acid, the acid becoming first yellow and then green, owing to the union of part of the oxygen of the indigo with part of its hydrogen determining the formation of water; he supposed that when it is thereby rendered soluble, it enters into a triple combination with the oxygen and sulphur composing the acid, regaining its blue colour with additional brightness either from its union with an increased proportion of oxygen, or from some effect resulting from the sulphur which had not been combined with it originally. Dr. Bancroft also observed, that after being dissolved by sulphuric acid, the indigo can never be restored to its original state; he, therefore, calls the whole sulphate of indigo. This was all that was known on the subject, when Mr. Crum commenced his researches, which may be found in the *Philosophical Transactions* for January, 1823. Having carefully repeated his experiments, together with the more recent ones of Berzelius, and having made a few observations myself on the various attendant phenomena, I propose to lay them before your readers.

It is only when impure indigo is employed that sulphurous acid is generated during the solution of that substance in sulphuric acid with either precipitated or sublimed indigo; although there is probably a decomposition of the acid, there is no indication of it; heat is invariably produced, and I think it is pretty evident that water is formed, and that the oxygen and hydrogen gases are furnished by the indigo, because the blue colour is always restored by the addition of water. The indigo during solution undergoes a change which is more or less complete, according to the time the substances are left together and the degree of temperature to which they are exposed. In about 24 hours, at the ordinary heat of summer, the indigo is converted into a new substance, for which Mr. Crum has proposed the name of *cerulin*.

To produce cerulin, I digested precipitated indigo for six hours in very highly concentrated sulphuric acid, and then poured the thick blue liquor into distilled water, sulphate of potash* precipitated a dark blue substance, which was thrown on a filter, and washed with a solution of acetate of potash,† and subsequently with alcohol; while wet, the new substance had a dark blue colour, but when dry it was copper colour. Mr. Crum calls it cœruleo-sulphate of potash. When a portion was burnt, no purple fumes were formed, but a considerable quantity of ashes remained; it was highly deliquescent, 3 grains acquired in 5 hours, by exposure to the air, nearly $\frac{1}{4}$th of a grain in weight. I made a great many experiments to ascertain by what salts it was precipitated when dissolved in water, the so-

* The scientific reader need not be reminded that these remarks do not bear upon the radiation or absorption of heat accompanying light.

* Potash itself and some other neutral salts have the same effect.

† Mr. Crum ascertained that cerulin is not soluble in any salt of potash, although it is almost to any extent in hot water; he recommends the acetate as possessing the advantage over the muriate or sulphate of not being precipitated by alcohol from a weak solution in water as they are. It may consequently be afterwards removed by washings with alcohol. —See note DD to the 2d volume of Ure's Translation of Berthollet on Dyeing.

lution being of such a strength that a candle appeared when viewed through it in a test-tube of a purple colour; the results were as follows:—

Prussiate of potash	blue.
Acetate — do.	blue.
Carbonate — do.	blue.
Nitrate — do.	blue.
Sulphate — do.	blue.
Tartrate — do.	blue.
Muriate — do.	blue.
Iodide of potassium	blue.
Muriate of soda	blue.
Carbonate of soda	blue.
Borate of soda	no change.
Phosphate of soda	no change.
Muriate of ammonia	no change.
Nitrate of ammonia	blue.
Nitrate of barytes	blue
Nitrate of silver	liquor turned mouse colour, but no precipitate.
Nitrate of mercury	blue.
Acetate of lead	blue.
Nitrate of strontia	blue.
Solution of gold	colour destroyed.
Muriate of iron	no change.
Sulphate of iron	no change.
Nitrate of copper	no precipitate, but one drop of a solution of ether caused the flame of the candle to appear blue.
Sulphate of copper	no precipitate, but one drop of a solution of ether caused the flame of the candle to appear blue.
Sulphate of magnesia	no change.
Sulphate of zinc	no change.
Muriate of lime	blue.

All these blue precipitates appeared to be the same; being dissolved in sulphuric and boiling muriatic acids, forming fine blue solutions—and forming colourless solutions with nitric acid. Mr. Crum supposes cerulin to be a compound of 1 indigo +4 water.

At the commencement of the solution of indigo in sulphuric acid there is produced a purple liquid, and if the action of the acid is stopped before cerulin is formed, this purple may be insulated, and obtained in a separate state. If that acid prepared from the dry proto-sulphate of iron, and called after the place at which it is made, Nordhausen acid, is used, the dilution with water must be made immediately after solution, but with the common acid* it requires two or three hours for its formation; if, however, heat is employed, ten minutes is sufficient. After the dilution the whole must be thrown on a filter, a blue liquid passes through, and indigo-purple remains; this is washed with distilled water till the blue colour is extracted, and from this the indigo that has been changed may be precipitated by muriate of potash, and subsequently washed with distilled water till the washings cease to form a white cloud with nitrate of silver. The substance remaining on the filter Mr. Crum calls phenicin, from the Greek word *purple*; like cerulin, the solution in water is blue, but it is sparingly soluble; it was precipitated by every salt I tried. It is turned green by caustic alkalies, in which it seems to resemble syrup of violets; by standing, however, the green colour soon vanished, and a purple powder slowly collected. Mr. Crum considers it to be a compound of 1 indigo +2 water.

PERSPECTIVE MADE EASY.

(Continued from page 194.)

5. The *vanishing point* of any line beginning at the picture-sheet is the point in fig. 2, which terminates the perspective of the line when it is extended to an indefinite distance from the point where it commences in the picture-sheet; thus, the point *c*, in fig. 2, is, as was shown before the vanishing point of the line *d e*, in the ground plan; and this same point *c* is the vanishing point of every line running parallel to *d e*. The vanishing point of any line *k l*, fig. 1, running level with the eye, but inclined to the picture-sheet sideways, is found by drawing the line *c m*, in the ground plan, parallel to *k l*, till it meets the picture-sheet in *m*; and this point *m* is the vanishing point in the ground plan of the line *k l*, and of every line in the objects to be represented running parallel to it. From the points *k* and *m*, in the ground plan, draw lines *k k* and *m m*, perpendicular to *a b*, in the perspective view, cutting the horizontal line passing through the point *c*, in fig. 2, in the points *k* and *m*, the point *m* is the vanishing point of the line *k l*; and if the points *k* and *m* are joined, the line *k m* will be the perspective of the line *k l* when it is indefinitely extended. The point *m* in the perspective view is also the vanishing point of

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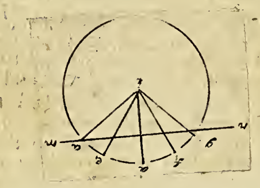
* Since it is of importance in all experiments of research to employ pure materials, it is advisable to purify the sulphuric acid used in these experiments, by diluting it with an equal weight of distilled water, and allowing it to stand till perfectly clear, afterwards evaporating in a glass retort containing pieces of platina (to prevent it from breaking), till of the strength required; by this means the sulphate of lead, which exists in considerable quantities in commercial sulphuric acid, may be completely separated.

every line in the objects to be represented, that runs parallel to the line *k l*. The vanishing point of any line commencing at the picture-sheet, or at this sheet produced, and inclined to it in the up or down directions as well as sideways, is found in the point, where a line drawn through the eye parallel to the line whose vanishing point is wanted, meets the picture-sheet. The reasons given in paragraphs 3, 4, and 5, to prove that *i*, in the ground plan, and *c*, in the perspective view, mark the vanishing point of lines running at right angles to the transparent plane, apply to lines running in the directions mentioned in this remark. You will now be able to find the perspective of any line running in any of the directions now mentioned, without the aid of the rule given in this paper, and you will also be able to make a variety of rules for finding the perspective of a point different from the rule that I have given.

6. From what has been said in paragraphs 4 and 5, it may not be plain to every one, how that the points marked *g* in the ground plan, and shown by the points *f d*, and the corner of the cube under *d* in the elevation, should have their positions in the same line, *h h p*, perpendicular to the line *a b* in the perspective view; or, in other words, it may not be evident, how in the case of every line in the objects to be represented, which has a perpendicular position, its perspective should stand perpendicular to the line *a b* in fig. 2. In order to understand this fully, let *a b c*, in the following figure, represent the end of a hollow cylinder, standing in a perpendicular direction with a number of plane surfaces *d i*, *e i*, *f i*, *g i*, and *a i*, radiating from its centre *i*.



Now, if this cylinder be cut parallel to its axis by any plane *m n*, the radiating planes will always be cut, so that their intersections with the cutting plane will be perpendicular; this is so obvious, as to need no demonstration. But the lines whose positions in the end-view of the cylinder are *d e a f g*, and which mark the places where the radiating planes meet the circumference of the cylinder, are perpendicular lines; each of which may be considered a line in some object to be represented, and *m n* will represent the transparent plane. Let the eye have a position any where in the axis of the cylinder—the rays of light reflected from the whole line *f*, or from any part of it, to the eye, will form a triangle in the plane *f i*, and the intersection of *m n* with this triangle will be the perspective of the line, or part of the line, whose position is *f*; but the intersection of the plane *m n* with the plane *f i*, is a perpendicular line; so the part of this intersection which forms the perspective of the line, or part of the line, whose position is *f*, must be perpendicular. The same reasoning applies if the lines in the objects to be represented stand at any of the other points, *d e a*, or *g*, or even if the line does not stand in a point in the circle representing the circumference of the cylinder; for in this case a new circle may be drawn, and every thing else can be shown as above. I may just mention it, for the thing can be demonstrated on the principles now developed, that level lines in the objects, running parallel to the picture-sheet, are also level in the perspective view; and lines in the objects to be shown, that are inclined to the horizon at any angle, and which keep parallel to the transparent plane, run at the same angle to the line *a b* in the perspective view of these lines. The top and bottom lines of the front side of each cube, and the top and bottom lines of the front side of the six-sided prism C, also the outside and inside lines that form the top angle of the pyramid, and some other lines in the figures, illustrate this remark. The lines now noticed, though indefinitely produced, have no vanishing point.

7. The eye should not be nearer to the picture-sheet than the greatest height or breadth of the picture; and it should be placed in the ground plan, so that a line let fall from it perpendicular to the picture-sheet should bisect the angle *x c b*, formed by lines drawn to it from the points which mark out the greatest width of the picture. The line *c i* in the ground plan does not bisect the angle *x c b*; but this was done to save room, and to show some parts of the objects that could not have been so well represented, if the position of the eye had been more nearly opposite to the centre of the picture. If the eye is very distant from the picture-sheet a perpendicular let fall from it to the picture-sheet need not fall exactly on the centre of the picture.

8. When the line drawn perpendicular to the line *a b*, in fig. 2, from the point in the ground plan whose perspective is wanted,

nearly coincides with the line drawn perpendicular to the same line *a b*, from the point in the picture-sheet where the line drawn to the eye from the point in the ground plan cuts it, the height of the perspective of the point cannot be so exactly found by the Rule, as the line drawn to the eye in the perspective view is in this case nearly a perpendicular line; and the place where this line cuts the line let fall perpendicular to *a b*, in fig. 2, from the point in the picture-sheet, where the line drawn to the eye from the place of the point in the ground plan cuts it, is not so exactly marked as when these lines which mark by their cutting the perspective of the point, cross each other in a direction nearer the perpendicular. When great exactness is wanted in a case of this kind, it will be the better way to find the perspective of a horizontal line, parallel to the picture-sheet, passing through the point whose perspective is wanted; and the place where this perspective line cuts the line drawn perpendicular to the line *a b*, in fig 2, from the point in the picture-sheet where the line drawn from the place of the point in the ground plan cuts it, is the perspective of the point.

9. When a number of circles are concentric, or nearly so in the ground plan, it will save drawing a great many lines, if, after the perspective of one of them is drawn, a number of the points taken in the ground plan of the other circles to draw their perspectives by, are in the lines drawn to the eye, which pass through any of the other circles, or in these lines produced from the points in the ground plan that were used in drawing the perspective of the first circle: as in this way, the lines already drawn perpendicular to the lines *a b*, in fig. 2, from the point is in the picture-sheet where the lines drawn to the eye cut it, will answer for all the circles. By taking the points in the ground plan of the other circles, to draw their perspectives by, where the lines let fall perpendicular to *a b*, in fig. 21 from the points in fig. 1, that were used in drawing the perspective of the first circle, cut them, a deal of drawing is saved; as one set of perpendicular lines to put the heights on, will pass through a great many points in all the circles. Produce the lines perpendicular to *a b*, if they are let fall from points on the side of the first circle, that is, towards *a b*. The perspective of any circle which stands in a plane parallel to the picture-sheet, is a circle. If a circle is placed in a plane which would run through the point of sight if produced, its perspective view is a straight line. The perspectives of circles having any other positions than the two now mentioned, are ellipses.

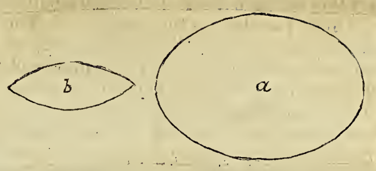


Fig. *a*, shows an ellipse; and fig. *b*, which is formed of two segments of a circle, is the way in which persons who do not understand the subject draw a circle in perspective.

ON CALICO-PRINTING.

By Thomas Thomson, M. D., F. R. S. L. and E. &c. &c.
Regius Professor of Chemistry in the University of Glasgow.

(*Continued from page* 142.)

13. WHITE DISCHARGE ON MADDER-RED.—When the aluminous mordant already described is printed on the cloth its basis (*alumina*) becomes fixed, and ready to combine with whatever colouring matter may be subjected to its action. Another mode of applying the same mordant, and producing patterns with it, is to impregnate the whole cloth with it, and afterwards to print the figure with a substance which has the power of rendering alumina soluble in water. The cleansing processes to which all cloths impregnated with mordants are subjected before dyeing, remove that portion of the alumina which has been rendered soluble, and leave portions of the cloth in the shape of flowers, crosses, &c. without any material capable of fixing the dye-stuff. When the cloth is dyed in the way already described these portions remain white, or at least become white after the requisite washing.

The substance which has been found to answer best for the removal of alumina and peroxide of iron is *citric acid*. Some of the advantages of such an acid are obvious. It does not corrode the cloth, though subjected to a considerable degree of heat. It is a fixed acid, with little tendency to swell or travel to other portions of the mordant than those with which it is intended to be combined; and it has the advantage over other vegetable acids of dissolving away very completely all the alumina or oxide of iron, so that no portion of these mordants is retained by the cloth. When we consider the ease with which this acid is abstracted by water, from the insoluble citrates, we would, à priore, infer that it is very little adapted for this purpose of the calico-printer, which, in fact, it is found to answer better than any other. But the probability is that water has no such tendency to abstract it from the soluble citrates, as *citrate of alumina, and citrated peroxide of iron.*

The citric acid is often printed before as well as after the application of the mordant. In the latter case it is generally assisted by *bisulphate of potash*, or even sulphuric acid, by which the more expensive acid is economized.

14. MADDER AND LOGWOOD.—The cloth is impregnated with the aluminous mordant which is discharged on the white portions by the method just described. It is then dyed with madder in the usual way, only a quantity of logwood is mixed with the madder. This logwood changes the madder-red to brown.

15. COCHINEAL PINK.—The cloth in this case also is impregnated with the same aluminous mordant, and the white portions are discharged by means of citric acid, in the way described in a former paragraph. It is then dyed in cochineal, which communicates a very beautiful pink.

For this beautiful dye we are indebted to America. Cochineal is the name given to a small insect which inhabits the *cactus coccinilifera*, and three or four other species of cactus, on which it remains immoveable, deriving its nourishment from the juices of the plant. It is a native of Mexico, and had been employed by the natives as a red dye. When the Spaniards entered the country in 1518, it drew their attention, and in 1523 Cortes received orders from the Court of Spain to procure as great a quantity of it as possible. The earlier Spanish writers describe cochineal as an insect ; but it came afterwards to be considered as the seed of a plant ; and this erroneous notion was not fully cleared away till about the middle of the eighteenth century.

ON MALT.

By Robert D. Thomson, M. D.

(*Continued from page* 144.)

1. The first step of the process consists in placing the malt in the steep, a square chamber, which is lined with stone and lime, and is usually sunk below the level of the barn floor, having been previously filled to the proper height with water.* The malt is allowed to remain here for not less than 40 hours, by legal regulations. The light seeds which swim on the surface are skimmed off, and the mass of grain is levelled, for the purpose of being gauged. The time during which the malt is allowed to remain in the steep varies, according to the wheel of the maltster. But the usual test of its fitness for being removed is the capability of its extremities being squeezed together between the fingers. New barley requires a longer period before it acquires this property than old does ; and *bigg* attains this consistence in a shorter period than barley. By this preliminary step the grain undergoes a partial germination. It absorbs water and swells ; English barley increasing $\frac{1}{4}$ in bulk, Scotch barley $\frac{1}{5}$, and bigg $\frac{1}{6}$.

In less than 24 hours after the grain has been introduced into the steep, the water begins to acquire a brown colour, and a peculiar odour. If this water is evaporated to dryness a blackish-brown residue possessing a disagreeable taste remains, which consists of extractive and nitrate of soda, amounting in weight, to $\frac{1}{50}$ or $\frac{1}{100}$ of that of the grain employed. About $\frac{1}{300}$th of its weight of carbonic acid is likewise emitted, which remains dissolved in the water, and continues to be disengaged after the grain has been taken out of the steep. And hence it is, that in ten days the grain not only loses all its additional weight, but gradually becomes lighter than at first. Thus, 100 grains of barley become, by steeping, 135. Exposed to the air for ten days they become 93·8. After a month they weigh 96 4, and after two months 100·8. Edwards, Colin, and Becquerel, have found that by causing grain to vegetate in water, acetic acid, sugar, and fermenting matter were secreted. The circumstance of the forms of carbonic acid, in this first stage, shews us that evolution is the preliminary step to germination.

The grain, after remaining in the steep, as has been said, for a period of not less than 40 hours, is drained. It is then cast, or removed, from the steep to the floor, where it is spread out in a rectangular form, to the depth of 16 inches, for the purpose of being gauged ; in this state it remains for 26 hours. The barley in the couch always occupies a greater space than in the cistern, from the absence of the pressure of superincumbent grain. This increase, which is very great in small quantities, diminishes proportionally to the increase of the quantity of grain. Thus if 3 cubic inches of barley are placed in a cylindrical glass jar, graduated to tenths of an inch, and are covered with water, in 96 hours the swell will be 0·3 inch , or $\frac{1}{10}$ of the whole ; but, upon inverting the vessel so as to shake the grain to the other end, it will occupy a bulk of 4·2 inches, indicating a swell of more than $\frac{1}{3}$.

On the other hand, when the quantity of grain is very considerable, it is found that sometimes its bulk in the steep exceeds that in the couch, but this may be, in some measure, owing to errors in guaging. Considering the bulk of grain in the steep to be expressed by 100, then the greatest bulk in the couch is 138, the least 110.6, the average 121·6. The officer of excise takes what is called the *best* guage, both in the couch and steep, or he takes the measurement of the grain when it has acquired its greatest bulk. One-fifth is subtracted from the bulk thus obtained, and the number obtained is considered as equal to the quantity of clean malt produced. The duty is charged accordingly; whether correctly or not seems doubtful.

* Professor Lavini finds the composition of wheat as follows : 1. Ripe corn contains 75 per cent. of starch ; uripe corn only 60 per cent. 2. Unripe corn contains $\frac{1}{4}$ of its weight of mucous extractive matter. 3. In unripe corn there is about $\frac{1}{30}$th of gluten ; in ripe corn 25 per cent. 4. The albumen is the same in both. 5. In unripe corn there is a green resin, amounting to about $\frac{1}{20}$th, which is probably converted into gluten and gum as vegetation advances. 6. Both contain oxides of copper, iron and manganese.—*Memorie della Reale Accadem dele Sciendi. Torino*, xxxvii.

ASIA.

	Name.	Height.
1	*Dhwalagin*	26,460
2	*Himaleh, Peak of*	25,750
3	*Jamatura*	25,505
4	*Dhaiban*	24,705
5 to 8	*Peaks of the Himaleh Mountains*	
9	*St Patrick Peak*	22,800
10	*Parkyal*	22,705
11	*Rudra*	22,395
12	*Peak*	21,775
13	*Rishi Gang Tong*	21,390
14	*The Cone*	21,180
15	*Black Peak*	21,120
16	*Petcha or Hamar*	21,005
17	*Bunder Puch*	21,910
18	*Peak*	20,505
19	*Low Peak*	20,115
20	*West Peak*	19,515
21	*Tawara Peak*	19,350
22	*Jhala Peak*	18,790
23	*Moonakor*	18,005
24	*Peak*	17,020
25	*Soomaonang*	15,405
26	*Ophir*	13,845
27	*Volcano*	12,405
28	*Chumarulee*	11,985
29	*Tigeretskoi*	10,705
30	*Katunayoiskoi*	10,655
31	*Awatska*	9,605
32	*Lebanon*	9,525
33	*Ararat*	9,505
34	*Me Lin Mountain*	8,205
35	*Jesso Peak*	7,681
36	*Sea View Hill*	6,505
37	*Olympus*	6,482
38	*Mount Ida*	5,805
39	*Corea Mountains*	4,381
40	*Forest Hill*	3,780
41	*GhautsMountains*	3,005
42	*King's Table Land*	2,830
43	*Carmel*	2,201
44	*Tabor*	2,005
45	*Hermon*	2,005
46	*Cunningham Mountains*	505

AMERICA.

1	*Chimborazo*	21,461
2	*Disco Cassada*	19,518
3	*Antisana*	19,135
4	*Catopaxia*	18,875
5	*Elie, Mont St.*	18,181
6	*Orizava*	17,375
7	*Sangai*	17,126
8	*Topian Range*	16,305
9	*Tunguragua*	16,205
10	*Rueu de Pichincha*	15,941
11	*Sierra Nevada*	15,705
12	*Gargaviraco*	15,681
13	*Nevada de Toluca*	15,205
14	*Fraide Peak*	15,131
15	*Pambamarca*	13,505
16	*Coffre Peak*	13,416
17	*Elias St.*	12,675
18	*Rocky Mountains*	12,505
19	*Cahouapala*	11,642
20	*Borma*	10,335
21	*Imbabura*	8,975
22	*Duida*	8,465
23	*Blue Mountains*	8,202
24	*White Mountains*	7,802
25	*Cuanarama*	6,502
26	*Stoney Mountains*	6,252
27	*Souffriere*	5,005
28	*Jorullo*	4,265
29	*Pellee Mount*	4,260
30	*Killington Peak*	3,505
31	*Alleghany Mountains*	3,005
32	*Black Hills*	2,302
33	*Ozark Mountains*	2,005
34	*Edgcumbe Mount*	1,405
35	*Sugar Loaf Hill*	1,305
36	*Torn Mount*	1,205

AFRICA.

1.2	*Geesh*	15,051
3	*Ami'd Mountains*	13,205
4	*Atlas*	12,505
5	*Teneriffe, Peak of*	12,360
6	*Lamalmon*	11,220

7	*Niewveldt*	10,006
8	*Compass*	10,005
9	*Gondar Mountains*	8,450
10	*Komberg*	8,008
11	*Taranta*	7,805
12	*Volcano*	7,682
13	*Camberg*	5,645
14	*Ruivo Peak*	5,162
15	*Khamies*	4,305
16	*Table Mountain*	3,580
17	*Diana Peak*	2,694
18	*Devil's Head*	2,320
19	*Hermanass Mountain*	2,082
20	*High Knoll*	2,004
21	*Conical Rock*	505
22	*Pyramids*	490

EUROPE.

1	*Mont Blanc*	15,730
2	*Mont Rosa*	15,605
3	*Ortler Spitze*	15,365
4	*Mont Serrin*	14,760
5	*Finster Aarhora*	14,103
6	*Jungfrau*	13,720
7	*Pelvoux*	13,440
8	*Shrek horn*	13,383
9	*Briethorn*	12,804
10	*Mount Viso*	12,582
11	*Wetterhorn*	12,205
12	*St. Michel*	11,780
13	*Venlatta Peak*	11,392
14	*Mont Perdu*	11,208
15	*Mount St. Bernard*	11,005
16	*Simplon*	11,005
17	*Mount Etna*	10,974
18	*Col Cervin*	10,505
19	*Terglou*	10,394
20	*Col de Traversetta*	9,964
21	*Roth horn*	9,642
22	*Conigu*	9,224
23	*St. Gothard*	9,080
24	*Lomnitz Peak*	8,872
25	*Velino*	8,390
26	*Arbizon Peak of*	8,345
27	*Anzeindaz Mount*	7,824
28	*Dofrafiel*	7,625
29	*Sterzingen*	7,515
30	*Priel*	7,005
31	*Olympus*	6,606
32	*Pentoux*	6,505
33	*Mont d' Or*	6,205
34	*Cantal*	6,094
35	*Sierra del Malhao*	6,005
36	*Reculet*	5,595
37	*Dole (la)*	5,415
38	*Chasseral*	5,265
39	*Tagoni*	4,905
40	*Puy de Dome*	4,854
41	*Snœ Fiall Jokul*	4,560
42	*Haidelburg*	4,465
43	*Vesuvius*	3,980
44	*Hecla*	3,695
45	*Stromboli*	3,022
46	*Kyria Mountains*	3,016
47	*Hornalen*	3,005
48	*Vaucluse*	2,154
49	*Flœy Feldt*	1,500
50	*Gibraltar*	1,443
51	*Valday*	1,205
52	*Mont Martre*	405

BRITISH ISLES.

1	*Ben Nevis*	4,370
2	*Cairn Gorm*	4,062
3	*Ben Lawers*	3,950
4	*Ben More*	3,872
5	*Snowdon*	3,572
6	*Carnedd Llewellyn*	3,500
7	*Ben Lomond*	3,425
8	*Sca Fell Peak*	3,170
9	*Sca Fell*	3,094
10	*Helvellyn*	3,050
11	*Skiddaw*	3,020
12	*Arran Fowddy*	2,960
13	*Goat Fell*	2,950
14	*Cader Idris*	2,920
15	*Brecknock Beacon*	2,860
16	*Saddleback*	2,790
17	*Grassmere Hill*	2,760
18	*Grisedale Peak*	2,680
19	*Croagh Patrick*	2,670
20	*Cheviot*	2,660
21	*Coniston Fell*	2,580
22	*Old Man*	2,580
23	*Pus of Japra*	2,472
24	*Plynlimnon Mount*	2,460
25	*Langdale*	2,405
26	*Ben Clach*	2,395
27	*Ingleboro' Hill*	2,362
28	*Carrock Fell*	2,295
29	*Carn Fell*	2,250
30	*Whin Fell*	2,242
31	*Caibsey*	2,045
32	*Snea Fell*	2,005
33	*Black Comb*	1,920
34	*Llandinan Mountain*	1,900
35	*Rivel Mountain*	1,870
36	*Holmee Moss*	1,860
37	*Pendle Hill*	1,834
38	*Lord's Seat*	1,750
39	*Pentland Hills*	1,752
40	*Lunkery Beacon*	1,670
41	*Carleton Hill*	1,560
42	*Rippin Tor*	1,548
43	*Penmaen Mawr*	1,550
44	*Campsie Hills*	1,505
45	*Malvern Hill*	1,440
46	*Cat Bell*	1,402
47	*Brown Willy*	1,370
48	*Wrekin*	1,330
49	*Carraton Hill*	1,209
50	*Butterton Hill*	1,205
51	*Hensbarrow Beacon*	1,035
52	*Rossbery Topping*	1,025
53	*Pontop Pike*	1,020
54	*Leith Hill*	990
55	*Orpit Heights*	985
56	*May Hill*	970
57	*Butser Hill*	920
58	*White Horse Hill*	9a0
59	*Arthur's Seat*	820
60	*Dunnose*	790
61	*Holyhead*	710
62	*Beachy head*	560
63	*Dover Castle*	470
64	*Shooter's Hill*	450
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For Review.

Bell's Comparative View of the Internal Commerce of Bengal during the years 1834-35 and 1835-36 accompanied with tables illustrative of the extent of trade carried on with each country and state.

THE INDIA REVIEW

OF WORKS ON SCIENCE,

AND

JOURNAL OF FOREIGN SCIENCE AND THE ARTS,

EMBRACING

MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS, &c.

REVIEW.

Some enquiries in the Province of Kemaon, relative to Geology and other Branches of Natural Science, by Assistant Surgeon JOHN McCLELLAND, *Member of the Royal College of Surgeons, in London, and of the Medical and Physical Society, Calcutta, Oct. pp.* 384.—THACKER & Co., CALCUTTA.

Continued from page 203.

We now commence upon Dr. McClelland's history of granite and the various superincumbent formations in the same consecutive order in which they occur; and we have reason to believe that this portion of our review will be read with interest by geologists in Britain, France, and America. Our author states that granite rock is found at Choura Pany, and that it penetrates through gneiss, and forms a succession of elongated elevations which constitute the basis of the highest district in Kemaon. The ridge extends in a north-westerly direction, for forty or fifty miles, and is terminated a few miles east of Choura Pany, by the great valley of the river Gogra. Our author says—

"This range appears to be an elongation of the Leti, Tirsal, and Dhanapur mountains, which form the eastern boundary of the valleys in which the Alacananda river rises; and may with great propriety be named, in the language of geographers, the *principal mountain chain:* while the great chain to which the snowy peaks immediately belong, may, in like manner, be called the *high mountain chain.* A better idea of the relative connexion of these chains may be formed, by the reader conceiving himself placed on Choura Pany. On the south, he sees the plains of Hindustan below him like a mist, and distant about twenty miles; on the north, the high mountain chain, or snowy peaks already described; and on the north-west, a succession of elevated mountains are observed, extending from Choura Pany, obliquely, towards the high mountain chain to which they are attached: these constitute the principal mountain chain, and this chain gives off subordinate groups, which, on the one side, pass in close succession to the plains, where they terminate in a line of steep declivities; and on the other, these lateral groups intermix with similar groups, given off by the high mountain chain, and forming between them the valleys of the Gogra.

This somewhat complex description would not have been required, were the chain of mountains to which it refers, as distinctly marked by their altitudes, as by their strata; but as this is not the case, and as the whole province appears, if superficially viewed, a mere chaos of mountains, we are not to lose sight of any indications presented by their internal structure, and particularly by the strata of granite.

The granite, as has been stated, makes its appearance only in the centre of this mountain chain, in the loftiest places, such as Choura Pany. It is stratified, and extends in the direction of N. W.; the strata are nearly vertical, and appear to be composed of nodula, around which concentric layers are wrapped, in the form of newer and newer deposite. This appearance may however be referred to the effects of weathering, as it is only observed on surfaces that have been long exposed. A similar appearance has been long since observed by Dolomieu, in blocks of granite, in ancient Rome; and also by De Luc, in the granite mountains of Silesia.

The colour of our granite is grey, sometimes of a reddish hue, derived from the felspar; but the usual colour is bluish grey. The mass is fine-grained, and resembles spe-

cimens I have seen of Aberdeen granite: the quartz is crystalline, but the felspar is dull and earthy. The latter appearance may be the effect of exposure to the weather, as I cannot depend on the perfection of the specimens examined; and from the great hardness of the rock, I was unable to detach fresher pieces. Its specific gravity is 2.71375."

Gneiss is next noticed, reposing on granite in strata which conform to each other, the transition between the two rocks being effected by imperceptible degrees. Alluding to the newer granite, Dr. McClelland says that the quantity becomes less crystalline and smaller in quantity in proportion to the other ingredients; and, disappearing, leaves chiefly felspar and mica, with a very small portion of amorphous quartz. The rock then becomes less compact, in which state it is found at the base; it thence extends in a north-westerly direction and forms the principal portion of the most elevated district in Kemaon, where denuded masses of granite, or more compact and durable gneiss, and green-stone are seen in remarkable order. At Dole, on the road between Lohooghat and Almorah, unconnected masses are heaped together in the form of a cone. Mountain masses of globular shape are accumulated on the verge of frightful precipices, so nicely balanced that the least force would serve to precipitate them into a dreadful abyss. Our author alludes to the ruins of Chompawut, the ancient capital of Kemaon, which was erected on gneiss at the northern side of Choura Pany, and says, it was totally destroyed by the decomposition of the eminence on which it stood. Our author is of opinion, that these stupendous rocks originally formed the nuclei in gneiss; and, from a peculiar tendency to decay, mouldered into friable earth, and was removed by the torrents, leaving masses exposed upon the surface. Dr. McClelland would thus account for the ruin of Chompawut, and the sinking and decay of mountains. We leave it to our readers to judge as to the correctness of these conclusions, and whether gneiss and other parts of the rock would have undergone such great changes as to destroy these cities by the imperceptible decay of the rocks on which they were erected.

"The strata of gneiss run in the direction of N. W. and dip 80° to N. E.; they vary in thickness from five to eight feet, and contain foreign beds of granite, green-stone, iron mica, and micaceous iron ore; also cotemporaneous veins of quartz and felspar.

Specific gravity of fresh specimens, 2-635. The mountains which are formed of this rock are usually rugged, and covered with dense forests of oak.

(A) FERRUGINOUS SLATE.

The rock to which this name is given occurs in subordinate beds in each of the foregoing rocks.

At Choura Pany, it is found in granite, in beds of a hundred feet thick. At Dole, about forty miles north-west of Choura Pany, a similar rock occurs, resting on gneiss. Its colour is blackish grey, with lighter and darker stripes on the surface of the cross fracture.

It occurs massive. External lustre glimmering; lustre of the principal fracture, shining, and of the cross fracture, earthy, or glimmering. Fracture, slaty, with a single cleavage. Fragments, tabular. It is semihard, inclining to soft. It soils. Specific gravity, 2·384.

PHYSICAL CHARACTER.

It has no effect on the magnet, either before or after exposure to the blow-pipe.

CHEMICAL CHARACTERS.

On exposure to the blue flame of the blowpipe, it slowly assumes a reddish yellow surface. It gives to borax a greyish green colour, inclining to greyish-white on the edges.

This rock might be named a mica-slate, containing a small portion of micaceous iron ore, finely disseminated with very fine granular quartz, common mica, and fine earthy felspar.

3.—HORNBLENDE-SLATE.

It has been shewn, that the two rocks, (gneiss and granite,) already described, form the principal mountain ridge, in nearly, but not quite, vertical strata: for a dip of 80° is invariably observed, bending to the northeast. This fact, together with others which are yet to be observed, renders it nearly certain, that a great basin or trough, of considerable depth, is formed by the substratum, or fundamental rock; descending from the centre of the high mountain chain, and ascending again to form the basis of the principal mountain chain. This basin, it would appear, is filled up partly by a number of successive layers, of newer and newer rocks, and these layers or strata are not uniformly spread over every portion of the cavity of the basin; but they are accumulated in particular places, and thus form subordinate troughs, or valleys; which have again been transformed by succeeding deposites of newer rocks.

Hornblende-slate appears to have been deposited chiefly in the bottom of this basin;

and to ascend only in small quantity, or to disappear entirely on its higher margins.* In these latter situations, it either assumes a coarse granular structure, and passes into gneiss, as on the southern acclivity of Choura Pany, and into mica-slate, as below Durgura; or it changes into a very fine granular description of clay-slate, as in the bed of the Lohoo river, on the northern foot of Choura Pany.

It may be more consistent with the nature and connexions of this rock, to imitate Werner and Professor Jameson, in considering hornblende-slate, not as a distinct formation, as described by Raumer†, but as occurring only in beds; but there can be no doubt that those beds are of much greater extent than either of those eminent geologists contemplated; and as the term *bed* affords too contracted an idea of a rock, which composes an extensive portion of a district, the inconvenience might perhaps be avoided by substituting the terms *partial formation*‡.

The direction of the strata of hornblende-slate is ruled, rather by the direction of mountain groups, than by that of principal mountain chains; or, in other words, its direction is subject to variation arising from local irregularities of the surface of the basin, in which it is deposited. The dip is seldom less than 60°, and often as much as 80°.

The acclivities of mountains composed of this rock are usually rugged and inaccessible; and tabular masses of nearly perpendicular strata stand several feet erect above the surface. From this peculiarity, soil sufficient for the growth of the most luxuriant vegetation is retained on the steepest acclivities.

Oak being in this latitude the inhabitant of loftier altitudes than are formed by this rock, the forests that prevail on it are chiefly composed of pines of the largest growth.

* On the S. W. acclivity of the principal mountain chain; or, in other words, the ascent from Belket to Choura Pany, hornblende-slate is found, at the altitude of 6,000 feet, to change into the character of gneiss; and in the course of this mountain acclivity, conical peaks rise one above another. The centre of each peak is composed of granular hornblende-slate, closely resembling gneiss, from which it only differs by containing hornblende sufficient to give it a greenish hue; while the strata surrounding these centres retain the character of hornblende-slate, until we ascend to the altitude already mentioned, which appears to be that at which hornblende-slate disappears.

† Annal. Phil. vol. vi. p. 478.

‡ To Raumer, green-slate occurred resting on gneiss and granite in the Riesengeberge; to Werner it occurred in clay-slate. In Kemaon, it is found resting on gneiss. To these we might perhaps apply the terms of first, second, and third trap (or partial trap) formations; but it is highly probable, that, in a more advanced state of Geological Science, these seeming irregularities may be reconciled to some general law, which has hitherto eluded our observations. This is the more probable, as our geognostic acquaintance with the structure of the earth is as yet confined to a comparatively small proportion of the whole surface.

The tract of district composed of hornblende-slate, although of considerable extent, is almost totally deserted; and the few villages that are found on it, are miserably poor, and, in general, uninhabitable for several months during the year; as well from the miasmata and heat that prevail in its dense forests, and deep valleys, as from the rapacity of the wild beasts by which these are infested: as the tiger, leopard, and the bear.

Hornblende-slate having been found in so many different positions, with respect to other rocks, a minute description of it, as it occurs in Kemaon, resting on gneiss, may be useful in assisting to form its separation into species, depending on the rocks with which it is associated in nature.

Its colours are seladon, pistachio, and olive-green.

It occurs massive, and contains cotemporaneous laminæ of quartz, in thin alternate layers, and flattish grains, from small to very small; and even finely disseminated. External lustre, dull, inclining to resinous. Fracture foliated, and slaty, with a single cleavage. Lustre of the principal fracture glistening, or shining, and of the cross fracture, glimmering. Shape of the fragments, tabular. Distinct concretions, lamellar. It affords a greenish grey streak. It is opaque. It is semi-hard. It is somewhat sectile. It affords an earthy smell when breathed on, and feels rather meagre. Specific gravity, 2·920.

Chemical characters. It is not fusible before the blow-pipe; probably from its intermixture with common clay, a large proportion of mica, and other impurities, as its lightness indicates.

Variat. a.—Coarse Granular.

Its colours are greenish grey, seladon, and pistachio green; with a pearly and glimmering lustre. Fracture, coarse granular; but somewhat inclining to slaty. Lustre of the fracture, resinous and slightly shining. Distinct concretions are lenticular, inclining on the one hand to lamellar, and on the other to granular. Specific gravity, 2·708.

It appears to contain felspar, as well as quartz, and may be considered as the transition between hornblende-slate and gneiss.

Variat. b.

Colour, dark greenish grey. Fracture, slaty in the large, but compact, even, and inclining to earthy in the small. Lustre, glimmering. It is opaque. It is similar in the streak. It is semi-hard, inclining to soft, and affords a strong bituminous smell when breathed on. Specific gravity, 2·728.

This rock is a transition between hornblende-slate and clay-slate; and appears to be composed of minute grains of quartz, imbedded in a basis of clay and hornblende.

The foreign beds, which are contained in hornblende-slate, are gypsum, micaceous iron glance, common iron glance, chlorit-slate, and primitive green-stone.

The first is common to this rock, and mica-slate, and will be noticed in the next.

chapter; and the description of the iron ores may be consulted in the account of the mines.

The chlorit-slate and porphyritic green-stone appear to be peculiar to this formation.

(B) CHLORIT-SLATE.

Its colours are emerald and grass green. It occurs massive. Internal lustre, pearly. Fracture, scaly foliated. Distinct concretions, thin lamellar. Lustre of the distinct concretions, shining. It is opaque, and it affords a light-coloured streak.

It is soft, and perfectly sectile. It is meagre to the feel. Specific gravity, 3.

It occurs in large quantity in the lower strata of hornblende-slate, and is found at Chimtouly, in the vicinity of the iron mines. It also occurs at the southern foot of Choura Pany, near Belket, where its scaly laminæ alternate with thin laminæ of quartz. It is the substance that gives the slaty structure to hornblende-slate.

(C) PORPHYRITIC GREEN-STONE.

This rock is found at the southern foot of the principal mountain chain, where it forms at Belket, a portion of the bed of the river Ludhoo. I have not been able fully to ascertain its extent and geognostic relations; and as this is a point of first-rate importance, it would be improper to hazard an opinion upon it.

It will be seen on inspection of the map, as well as from what is said in the description of Belket, that if the porphyritic green-stone passes under the elevated mass of strata composing the southern declivity of Choura Pany, that then those philosophers, who contend that the strata of mountains have been elevated to their present position, by the expansive operation of heat, confined in the centre of the earth, would find in the peculiar position of this green-stone, a strong argument in favour of their doctrine; but if, on the other hand, it should appear on further inquiry, that this formation, like the others we have described, presents the character of a deposite from above; then, of course, the first argument would come to nothing. This rock is composed apparently of equal parts of hornblende and felspar, in minute crystals, mechanically mixed, so as at first sight to look somewhat like a fine granite. It is not stratified, but divided in all directions by adventitious rifts, which give it a brecciated structure in large masses. The fragmented pieces are usually trapezoidal. It is hard, and not particularly heavy."

We now come to the primitive formations—mica-slate, clay-slate, and primitive limestone. Mica-slate is found at Durgura, alternating with gypsum, and a micaceous kind of clay-slate, which, from its geognostic situation, may be considered to be intermediate between mica-slate and clay-slate. This also occurs associated with similar rocks at Choura Pany; it rests on hornblende-slate, and is composed of small grains of quartz, some felspar, and a considerable proportion of grey or silvery mica. Mean direction of the strata W. N. W.; mean dip, 500.

Gypsum is found in beds from 50 to 300 feet thick strata, subdivided by numerous slaty rifts running parallel to the strata which seem to divide the rocks into tables from two to six inches. The colour of these strata is reddish white, and greenish white; lustre glimmering, and sometimes glistening in the principal fractures; while that of the cross fractures is pearly; large fractures slaty and tabular; small pieces wedge-shaped: it is faintly translucent on the edges; semi-hard and frangible.

"Specific gravity of the reddish coloured variety, from Durgura, 2·612, and of the greenish white kind, from the same place, 2·574 and 2·669; while a variety of the same from beds in hornblende-slate at Chimtouly, is, 2·3.

Chemical characters. It is infusible before the greatest heat of the blow-pipe, either when placed on charcoal or held in the forceps. Even with the addition of borax, and the flame directed to the edges of the laminæ, it evinced little signs of fusibility; nor is it soluble in any proportion of water.

These experiments were not made on the specimen from Chimtouly, which appears to be a purer gypsum than the others, from its more compact and sparry character, as well as from its containing less mica."

The extracts we have given shews fully our author's mode of description. He then proceeds to describe the great formation of clay-slate, which composes at least the sixth part of the whole province, and is stretched in conformable strata over the mica-slate and trap rocks. It commences on the N. E. acclivity of the principal mountain chain under the out-going of the substratum, at the elevation of 7000 feet. Primitive limestone composes the northern acclivity of Takill; and from thence it extends in a north-westerly direction for many miles.

"In a small river valley, which partly separates Takill from the Oudepore group, this rock forms the most frightful precipices on both sides that can well be imagined. These precipices compose broken, and seemingly tottering mountain acclivities, that ascend in places for three or four thousand feet, at various angles between 45° and

75°; and as the only road between Lohooghat and Petoragur lies along the verge of these precipices for several miles, it is impossible that the most indifferent traveller could pass, insensible either to the danger of his situation, or the beauties of the scene. This limestone is distinguished in the large scale, by its thick slaty appearance, owing apparently to occasional laminæ of argillaceous matter, which pass an uncertain length through each stratum, parallel to the strata seams. The strata are mantle-shaped, rather than conformable; or they may be said to partake of the nature of both. This variety of the rock is of a bluish grey colour, with a dull lustre."

Talking of mountain rocks, Dr. McClelland distinguishes them from primitive rocks by their position, greater irregularities in regard to stratification, and by containing obscure traces of organised beings, as well as by certain characters presented by the structure of the rocks themselves. In Shore valley there is a black, fine-grained limestone, resting in unconformable strata, on clay-state. In other parts of the district an impure, fine-grained limestone is found mechanically mixed with newest clay-slate, in thin slaty lamillæ.

"Transition rocks are clearly indicated in the mountains of Kemaon; grey wacke, and grey wacke-slate are both absent, and their place is supplied by a rock composed of a mixture of magnesian lime-stone and argillaceous clay: and lastly, however adverse to our former notions, we shall be obliged to admit magnesian limestone into the class of transition rocks."

The oldest transition limestone is found on the western acclivity of a lofty mountain near Lohooghat extending to the north; it is scarcely stratified, but disposed in an unconnected succession of tabular masses, of the colour of Berlin blue.

"Lustre glistening. Fracture compact, large conchoidal. Distinct concretions, fine or very fine granular; the fine granular concretions are somewhat angular, and have a dull dark-blue colour: while they are surrounded on the fractured surface by minute splinters, which appear to the naked eye like very fine white specks.

It is opaque. It is semi-hard.
It is entirely dissolved with brisk effervescence in acids."

Aluminous slate and limestone are formed of alternate layers of limestone and slate; the limestone ingredient being generally magnesian.

"Limestone portion is combined in a mechanical alternation of layers, with ordinary transition slate.
Specific gravity of the greenish coloured variety, 2·75, and of the bluish kind from Takill, 2·647."

Speaking of transition limestone, Dr. McClelland says that it forms two varieties: the most important is somewhat stratified and conformable, and in conjunction with clay-slate forms whole mountains and even mountain groups. Beds of graphite sometimes intervene between the slate and limestone.

(A) OVERLYING VARIETY.

"This variety of transition limestone occurs in distinct masses, of various shapes and sizes; the former frequently irregular, but often rhomboidal, cubical, columnar, seldom round. They occur singly, or in large numbers, piled loosely together in the form of bold rugged knolls, mountain shields, and caps: more rarely, two or three enormous isolated blocks are so nicely balanced upon each other, as to convey the idea of their having been so placed, by some artificial power beyond our conception. Their external surface is granulated and uneven, often also streaked by projecting lines.
Its colour is velvet black, with numerous spots and veins of white calcspar.
Fracture, large conchoidal, inclining to granular foliated. Fragments, indeterminately angular, and rather blunt-edged. Lustre of the fracture, glimmering, sometimes glistening.
It is opaque. It affords a white streak. It is semi-hard. Specific gravity, 2.8435 and 2·8668.
Chemical characters. The same as the foregoing.

It sometimes rests on the foregoing variety, with which it usually occurs; it also rests on clay-slate, and is extensively distributed on mountain ridges and acclivities in the vicinity of Shore, between the altitudes of five and seven thousand feet. The spotted variety in particular is a beautiful marble, and would be highly esteemed, if within the reach of a people whose knowledge of the arts enabled them to appreciate its value.

Along with these limestones, beds of green-stone, slaty talc, and graphite are very common. The transition green-stone and the graphite are peculiar to this formation, but the talc also occurs in floetz limestone. The stratified variety is also the repository of copper pyrites."

Dr. McClelland next notices compact Dolomite, mountains of which are seen rearing themselves out of the narrow valley of Belket.

"The beautiful green and blue colours of their naked precipices; the picturesque form of their lofty summits, as well as the

uniform arrangement of their massive, and nearly perpendicular strata, convey, upon the whole, a most sublime effect."

Oolite or grit-stone composes a lofty range of mountains on the north of Gungowly.

"Colour of the rock is yellowish white; surface rough; external lustre, none. Internal lustre, inclining to vitreous.

Fracture compact, uneven, inclining to coarse splintery on the one hand, and to large conchoidal on the other.

Fragments, irregular, blunt-edged.

Distinct concretions, fine granular. Surface of the distinct concretions, smooth. Lustre of the distinct concretions, vitreous.

It is translucent on the edges. It is similar in the streak, and semi-hard. It is not particularly brittle; is easily frangible, adheres slightly to the tongue, and often affords a grating sound when handled. Specific gravity, from 2·6 to 2·5975.

Chemical characters. It dissolves very partially and with feeble effervescence in nitric acid.

It becomes enamelled on the surface after exposure to the blue flame of the blow-pipe, with the addition of borax."

Dr. McClelland proceeds to notice the peculiarity of the older strata, and describes miscellaneous rocks, granatine, fibrous limestone, common talc, minerals associated with talc, variegated clay-state, brecciated serpentine, noble serpentine, &c.

"The immense accumulation of primitive rocks, which composes the alpine land, extending to the high mountain chain, must occasion a pressure on the side of the Himalayas calculated to force the vertical strata of granite towards the plains, the side on which it is least supported*. What strengthens this view is, that clay-slate, a rock that constitutes two-thirds of the acclivity on the side of the Himalayas, is quite absent on the opposite side next the plains.

Were it not for this explanation, the granite would be taken for a newer formation than the gneiss and hornblende-slate on which it seems to rest, a transposition of rocks which is contrary to all established principles of geognosy, and which we could not receive unless confirmed by the most extensive and careful observations, such as would embrace the Himalaya range from Tartary to Hindustan."

* "As the waters which formerly assisted in supporting the mass of mountain began to lower their level, those masses then lost their former support, yielded to the action of their weight, and began to separate and be detached from the rest of the mountain, falling to the free side as that where least resistance was opposed." Werner. Vid. New Theory of Veins.

Granatine, found in extensive beds of clay-state, is often associated with copper and iron pyrites. Fibrous limestone occurs along with common talc, at the north-eastern extremity of the Oudepore mountain. Its colours are lead grey, greenish and bluish grey, clouded and striped with smalt blue. Common talc is found with this and granatine; its colours are bluish, and greenish grey; lustre between pearly and metallic. Variegated slate is found in the district of Shore resting on clay-state in mantle-shaped strata. Brecciated serpentine is found at Jula ghat, where it forms the bed of the Mahi-Kali river. It is stratified and conformable; direction W. N. W. dip 40 E. N. E. Its colour is greyish black. Dr. McClelland proceeds next to notice floetz rocks, which are divided into three beds, viz. copper-slate, alpine limestone, and tabular limestone; of which he gives the following description.

(A) COPPER-SLATE.

"This rock composes a large proportion of the Shore district. It extends along the bases and acclivities of the primitive and transition mountains, forming in these situations, a succession of small subordinate basins occasioned by the circuitous contortions described in the direction of the strata. The strata are usually made up of layers which are separated by rifts, and transversely broken, so as to give the whole a comminuted, thick slaty appearance.

Between the fractured parts in the lower strata, nests of bituminous fossils, talc, copper and iron pyrites occur.

(B) ALPINE LIMESTONE.

Mountain, or alpine limestone, occurs in lofty irregular accumulations, which rise abruptly in the form of rugged, often isolated pyramidal mountains, whose acclivities are formed by the almost perpendicular rearing of tabular masses, while their declivities are composed of unconformable, brecciated, homogeneous mountain-masses, presenting few external traces of the tabular, or stratified structure, but merely cemented together. and perforated by caverns, fissures, and subterraneous waters. The bases of the mountains of alpine limestone are overspread with masses precipitated from above by some natural convulsions, and again agglutinated by the same or succeeding catastrophies, and transformed into subordinate knolls, mechanically, as well as chemically, grouped together in the most sublime and picturesque forms."

(C) TABULAR AND MANTLE-SHAPED VARIETY.

This rock occurs in patches, pretty extensively distributed on low shields and valleys,

throughout the Shore district. The strata are subdivided by slaty rifts like the copper-slate, but unlike the latter, they are almost always flat and seldom or never form basins, or contain bituminous talcose, or metallic fossils; but are distinguished by containing concretions resembling small fishes.

These several varieties of limestone are scarcely to be distinguished from each other, by their external or chemical characters; which may be set down as follows:

Colours, bluish-grey and ash-grey. Externally tarnished with dirty greyish white. Sometimes the internal and external colours alternate on the surface, giving the rock a variegated flinty appearance.

External surface smooth, and without lustre. Lustre of the fracture dull. Fracture compact, large conchoidal, inclining to fine splintery. Fragments irregular, somewhat sharp-edged. It is feebly translucent on the edges. It affords a light-coloured streak, and is capable of being scratched by the knife, but not without difficulty. Specific gravity, 2·732.

Chemical characters. It dissolves completely, with brisk effervescence, in nitric acid, and burns to a fine white quicklime without falling to powder."

Magnesian limestone occurs as a partial deposite along the course of the small river that drains the valley of Shore. The strata are nearly horizontal, or seldom dip more than 15°. Vesicular limestone is a coarse breccia, composed of fragments of transition and floetz limestones. Porphyritic septarium occurs in overlying masses near the highest ridges and summits of Takill composed of common felspar, as a matrix to fragments of transition limestone. Hornstone, an oil green, and greenish grey, faintly clouded with siskin green, occurs in massive forms. Arragonite is found near the village of Gooseragong in Shore valley. We now come to the alluvial rocks.

"In Kemaon, as in all other mountainous countries, we can have no such uniformity in alluvial deposites as in low countries; but the phenomena connected with their production can be here studied with more advantage, as mountains are the great natural laboratories in which alluvial rocks are prepared, and from which they are transmitted to fertilize the earth.

Alluvial deposites are derived from the disintegration of the older rocks, by the destroying agencies of heat, light, moisture, and we may perhaps be allowed to add, of earthquakes, and the attrition of winds. It may indeed be improper to designate as *destroying* those effects that keep up the never-ceasing supply of alluvial soil, so essential to the existence of the inhabitants of this globe, vegetable as well as animal. In Kemaon, the varieties of these deposites are few, and differ frem each other according to the source from which they were derived. In arranging them, we cannot follow any rule founded on priority of formation, the changes that produce the different varieties being simultaneous."

Siliceous alluvial deposites derived from the most elevated ridges of granite and gneiss contain quartz of pure siliceous earth. Aluminous clay is next noticed as presenting varieties. Dr. McClelland had no opportunity of seing volcanic rocks in Kemaon except the septarium.

This, properly speaking, brings us to the end of Dr. McClelland's work on the geology of Kemaon. There are other chapters on the mines of the north eastern frontier of Kemaon; on climatology and on earthquakes; a general view of the zoology of Kemaon, and an enquiry into the causes of goitre, which we shall notice hereafter. We however cannot close this review without strongly recommending the work to public support: we have not ventured on any commendation without, in the first place, exhibiting a copious outline of its contents, that our readers might thus be better able to judge of the great value of a work which exhibits the geology of one of the most interesting portions of British India. The information contained in the work is conveyed in a language as chaste as it is lucid; and in the course of the undertaking the author has evinced no common degree of talent and research.

Art. II.—Results of an Enquiry respecting the Law of Mortality for British India, deduced from the Reports and Appendices of the Committee appointed by the Bengal Government in 1834, *to consider the expediency of a Government Life Assurance Institution. By* CAPTAIN H. B. HENDERSON, *Assistant Military Auditor General, Secretary to the Committee. Transactions of the Asiatic Society,* 1836.

Subjects of the nature contained in the paper we are about to examine are of infinite

importance, not only on account of the information they convey, which governs the value of annuities dependent on the exigencies of human life, but also as affording data in regard to the degrees of healthiness of situations and the probable duration of human life. In the article now before us there is a greater number of statements brought forward, tending to elucidate the rate of mortality, than in any other treatise we have seen on the subject. To the civil and military branches of the Hon'ble Company's service, who are doomed to pass the principal period of their existence in this country, it becomes a subject of great moment to know the degree of mortality to which the British sojourner in India is exposed. In a statistical point of view the present investigation is of the utmost importance, as has been observed in another work ; for it is impossible to regulate with any degree of accuracy the scales of pensions without a strict reference to the rate of mortality among different classes of individuals,both prior and subsequent to their being admitted on the pension list. The ascertainment of this point is therefore of infinite importance to the officers of the army. No rule either for the promotion of officers or for retrenchments against them, can be laid down without a previous knowledge of the mortality to which they are subject in different climates and under different circumstances, as regards cantonments and garrisons in India. But there is another question yet unsettled, which leads to accurate conclusions ; viz. whether or not India is inimical to the health of the children of Europeans, and whether it is indispensably necessary to send them to Europe in order to preserve and establish their health. On analysing the paper before us we, however, find that matter of so vague a nature has been introduced, as to create doubts whether sufficient care has been taken to arrive at accurate conclusions. Alluding to the natives, for instance, Captain Henderson observes that there are few tabular statements available, or data so extensive as to exhibit the general ratio of mortality in India, as compared with that of the population of other parts of the world. So true is this observation, that we are rather astonished that our author should have referred to the statement of the population, births, marriages, and deaths, in the city of Delhi. Writers in Europe might notice such statements as being accurate; but we will venture to say they are the very reverse. When Captain Henderson alludes to the native soldiers, he has however better data to go upon. Of these there are regular stated returns forwarded to the public departments, but much dependance cannot be placed on those returns, and on the mode of calculation adopted, as to admit of our coming to the decision that the conclusions arrived at are correct. Captain Henderson says that the native soldiers on the Bengal establishment are particularly healthy under ordinary circumstances. He takes a period of five years, and states that only one man is reported to have died per annum out of every one hundred and thirty-one of the actual strength of the army. These tables are taken, we perceive, from the returns to the Medical Board. In order to prove the accuracy of these data, we should like to have seen these returns compared with those sent to the Adjutant General's office.

We very much doubt the correctness of the statement in the third column of table No. 1 which gives the total strength of regiments in monthly averages. Medical men do not obtain this item of information so numerically correct as conveyed in returns to the adjutant general of the army by adjutants of regiments. If then the statement is incorrect in this column, the result developed in the table must be altogether erroneous. We ourselves believe the mortality to be much greater than here given, which is our reason for objecting to the single source from which this information appears to have been derived. On this account the table, which would otherwise have been rendered of great importance, becomes in our estimation valueless. Capt. Henderson adverts to the climate, we presume, of Bengal Proper, as being injurious to the sepoy, and assures us that, although only one-fourth of the troops exhibited are stationed in Bengal, the deaths of that fourth are more than a moiety of the whole mortality. There are grounds for this excess in the number of deaths in Bengal. Besides the influence of climate, the bosom of a Hindoo soldier is extensively occupied with the love of his kindred, his religion, and his money ; and the moment he enters Bengal Proper, these passions are remarkably developed. To provide for his family he deprives himself of the common requisites of life, and, as rice is to be purchased at an extremely low rate, he lives upon the cheapest; regardless of its quality, he looks only to the quantity. Thus he leaves off the use of meal and ghee, which he was in the habit of making into cakes—the diet to which, in his native land, he had been accustomed from his childhood. It

is, we conceive, exclusively owing to this poverty of diet and his other privations, to which we have alluded, that such numerous deaths among this class of our soldiery are to be ascribed. Again Captain Henderson states that the sepoys are "healthily employed, well clothed, and attended." In the upper-provinces we admit this to be the case generally, but not the native corps in Bengal, which are scarcely more than skeletons of regiments. The duty of troops, especially from Barrackpore, is so incessant, as to render it the reverse of healthy employment. We understand that when European guards are relieved, the natives, owing to a paucity of them, have been obliged to stand still. We ascribe the fewness of the deaths and healthiness of our native army to a highly efficient medical department; and it corroborates the opinion we have so repeatedly endeavoured to enforce upon the mind of the Government that the best policy and system of economy will be to secure well educated men to fill the medical list, not by reducing the allowances of incumbents, and thus impoverishing them, but by improving their condition. The following quotation from our author shews a large pension list, and but a few transfers to it, except as the last alternative.

"It would seem by other documents that out of about eighteen thousand invalid fighting men, of the Bengal Army pensioned by the State, six hundred and eighty deceased during the year 1831-32, or one out of 26½; while the average duration of the pension enjoyed by this class of men, for a period embracing from May 1828 to October 1830, was 7 years 8½ months, and from May 1831 to the same month in 1832, the duration of pension was only about 5 years 4½ months."

We perfectly agree with our author, that the possession of an accurate census of the large populous cities, with regularly published annual statements of the births, marriages, and deaths, is still a desideratum: but at present we see no means of supplying it with that accuracy which such statistical tables require to render them at all available for calculations of the nature found in our author's paper. The pilgrimages, the wandering character of the people, and their peculiar customs, so diametrically opposite to those of other nations, are the difficulties which present themselves to the compilers of such records.

We now proceed to examine the rate of mortality among Europeans sojourning in India, as presented in the tables before us. Captain Henderson considers the population of this class to be fluctuating. There was some uncertainty with reference to the other presidencies as to the real ratio of decriment in their immediate communities; yet, on account of the regular constitution of the covenanted services under each Government, in Capt. Henderson's opinion, there are greater facilities for obtaining scrupulous accuracy as regards dates of arrivals, deaths, and age in India. Captain Henderson's report commences with an enquiry into the mortality among the common soldiery. The information is furnished by the late Dr. Burke, Inspector General. In addition to information on other points, this report embraces the casualties of the last four years for the whole of his Majesty's Army in Bengal.

"But he exhibits a curious distinction in the rate of danger at the different stations; viz. Deaths to strength. Fort William, 7.59 per cent. Berhampore, 6.77; Chinsurah, 6.10 do. Cawnpore, 4.55; Boglepore, 3.95 do. Dinapore, 3.84 do. Ghazipore, 3.80 do. Kurnaul, 3.00 do. Meerut, 1.99 do. Agra, 1.91 do.

With respect to the ages of the deceased, the Inspector General has now given more ample information. During the four years 1826, 27, 28, 29, the ratio of death was—

From the age of 18 to 20, 16.12; 20 to 25, 9.35; 25 to 30, 10.13; 30 to 35, 6.92; 35 to 45, 9.54.

In the above term were included the extraordinary casualties of the war in Ava and the siege of Bhurtpore. But in the four succeeding years of peace and non-exposure of the troops; viz. 1830, 31, 32, 33, the ratio grows more regular, and assumes the generally steady progressive increase of danger with increasing years, the same as in all the other Tables in possession of the Committee of officers and others; viz.

From 18 to 20 years,	......	0.58 per cent.	
20 to 22	,, ...	2.24	3.44
22 to 24	,, ...	4.63	
25 to 30	,, ...	5.86	
30 to 35	,, ...	5.22	
35 to 45	,, ...	6.78	

It should be remarked that from 18 to 20, during these four years, the class above represented, consists of recruits enlisted in India, the sons of soldiers of the regiments."

We shall conclude our notice of this article here, and resume it in our next.

Art. III.—Notes on the Geology of the country between Madras and the Neilgherry Hills, viâ Bangalore and viâ Salem, by P. M. Benza, Esq., M. D. *of the Madras Establishment.*

On the Geological position and association of the Laterite, or Iron Clay, formation of India; with a description of that rock as it is found at the Red Hills near Madras, by R. Cole, Esq., *of the Madras Medical Establishment, Secretary to the Asiatic Department of the Madras Literary Society and Auxiliary Royal Asiatic Society.—Madras Journal, July,* 1836. J. B. Pharoah, *Madras.*

Dr. Benza opens his article by giving a concise statement of the geological features of the plain near Madras, with the view of communicating the names and nature of the rocks in that direction. Granite is the lowest rock in almost all the localities of the plain; it is composed of quartz, felspar, and mica. The fact, that granite was always the lowest rock, was ascertained on boring for water and excavating for tanks and wells. This rock is found in many parts of the plain on the surface of the soil in clustered masses; near the mount and the race-course these eminences of granite are intermixed with pegmatite. In addition to other minerals at the foot of Palaveram the granite contains garnets: in some places it loses the mica and becomes pegmatite. At the western extremity of the mount the granite rocks are decomposed, forming white clay. Dr. Benza infers from the superficial position of the granite over the whole plain of Madras, that boring for water would prove unsuccessful. Porphyry, formed of well defined and separate crystals of felspar imbedded in a compact paste of a similar mineral, occurs in the plain between Guindy and Trimatoor. No hornblende, and but few plates of mica are discovered in the porphyry, Hornblende slate, occasionally passing into hornblende rock, overlays the fundamental rock in the little eminences of the plain. The stratification of this rock is well developed—the contorted strata being composed of coarse materials; some are in a more comminuted state, forming a fine grained stratum. The rock is composed of an endless variety of proportions of minerals; in some blocks strata of hornblende is exclusively distinguished, in others felspar and quartz; in some simple quartz, which occasionally intersects the strata at all angles and in different directions in very thick veins. Hornblende rock, in huge masses on the summits and sides of the hills, is foliated, shining, and nearly black; contains little felspar; is stratified in appearance; and is the primitive greenstone found all over India. Fracture splintery, texture tough and compact.

Conglomerate laterite extends over the whole eastern part of the plain, overlaying the granite in many places; it is found in two states—viz. undisintegrated and detritus: it is found in its entire state, on the banks of the Adyar, overlaying the pegmatite. The detritus has two geological positions: one as loose rounded pebbles, scattered over the surface of the plain; the other as substratum to the soil. Between the lateritic detritus and the granite is found, in some places of the plain, a stratum of nodular kankar; in some spots it resembles friable, calcareous tufa. Trap is met with in considerable dimensions in loose blocks, or in dykes between Palaveram and Trimatoor, where they are nearly level with the soil or forming small swellings on the ground. The boulders and the dykes are composed of basaltic hornblende: these dykes are frequent in India. As we approach the sea the surface of a portion of the plain is sandy, intermixed with minute grains of disintegrated garnets. In the clayey stratum inland, marine organic exuviæ have been found.

Such is an outline of Dr. Benza's sketch of the geology of the environs of Madras, by which he has rendered great service to science, and supplied an important desideratum in Indian geology. The work is highly creditable to this author's perseverance and zeal. Before we accompany him on his journeys to the Neilgherries, we must examine Mr. Cole's

account of the geological position and association of the laterite or iron-clay formation of India, with his description of the rock near Hurdwar, just alluded to by Dr. Benza: we should add by the way that, in allusion to the marine organic exuviæ said to have been discovered, Dr. Benza comments upon the importance of inquiring into the existence of their fossils. Dr. Voysey was one of the first to mention the existence of marine and fresh water shells in a fossil state in the south of India. In 1822, Col. Cullen deposited in the museum of the College of Madras shell limestone, found in the Northern Circars, forty miles from the sea-shore; and Mr. Malcolmson has given an account of the geological position of fossil shells found under trap between Hydrabad and Nagpore. Dr. Benza says that these geological appearances confirm the accounts given in the Puranas, viz. that "it has been handed down by tradition that the greatest part of the Coromandel Coast was suddenly elevated out of the sea." Mr. Cole justly considers it an opprobrium on science that so little is known concerning laterite—a mineral so extensively distributed and of so marked a feature in Indian geology; and proceeds to give a succint account of what has been written on this rock. Buchanan, in alluding to the hills of the country, mentions that iron ore is found forming beds, veins, or detached masses, in the stratum of indurated clay; to this he was the first to give the name *laterite*. This is not the indurated clay of Kirwan, but apparently the argilla lapidea of Wallerius. It is diffused in immense masses, without any appearance of stratification, and is placed over the granite that forms the basis of Malayala. It is full of cavities and pores, and contains a large quantity of iron in the form of red and yellow ochres. Excluded from the air it is soft; when cut it becomes as hard as brick and resists air and water. It is cut into the form of bricks, being one of the most valuable materials for building; in several of the native dialects it is called the brick-stone. Where, by the washing away of the soil and exposure to the air, it is hardened into a rock, its colour turns black, and its pores and inequalities somewhat resemble the skin of a person affected with cutaneous disorders; hence, in the Tamul language it is called itch-stone. Dr. Buchanan, speaking of the minerals of Rajmahal hills, says that "south from Mansahandi, at Jajpar on the borders of Birbhum and Murshedabad, there is a hill, which consists chiefly of this clay. It is a kind of breccia, and contains ferruginous nodules in an argillaceous cement. Babington, in his paper on the geology of the country between Tellicherry and Madras, alludes to hills of a rounded form composed of the ferruginous stone, which he distinguishes by the name of Buchanan laterite. In the porous rock, the red ochry part is the matrix, the kidney-shaped interstices are filled with white earth, alluvial formed from the washings of the ghaut mountains. In these the hornblende decays into a red oxyd, and the felspar into porcelain earth. When this alluvial rock is exposed, the white parts, says Babington, are washed away, and a porous ferruginous stone is left behind. The primitive rocks underneath appear in many places above the coast midway between Calicut, Tellicherry, and Moy. Four miles inland from Calicut are two low hills composed of cubic iron ore. The laterite forms the hills. Near Manantoddy, there is a quarry of laterite. The rocks in Mysore decay, leaving a whitish soil beneath the surface, owing to the quantity of felspar they contain. The dark particles of hornblende become ferruginous, and this in general forms the top of the mountain, which is reddish. Little fragments become rounded, and in some cases at Bangalore the whole is settled into the ferruginous stone. In the detritus of these rocks, it does not seem that particles of felspar are washed away until they are decomposed: water percolates through the mass and carries off the other constituents of the sienite, leaving the felspar in a decayed state in mass. Voysey alludes to wacken passing into iron-clay and forming elevated table land at Beder, which is 2,359 feet above the level of the sea. Voysey represents that it closely resembles that of

the red hills at Madras, Nellore, Singhirikunda; in the two latter on granite: he observed in it plumb blue lithomarge, and pisiform iron ore. The origin of this rock may therefore, in Cole's opinion, be attributed to the basalt and to the wacken, not only in the Hydrabad country but in three other localities, where the mineral is said to prevail closely resembling that near Hydrabad, which is his authority for considering laterite as associated with the trap formation. Captain Coulthard talks of the iron-clay in the Saugor district. The Rev. R. Everest, in the *Gleanings of Science*, alludes to having seen the laterite. Mr. Malcolmson states that the Indoor and Nirmal magnetic iron rapidly becomes red on exposure, and the rock, on being broken and the ore separated by washing, leaves a reddish clay. Veins of quartz pass through the granite and sometimes contain magnetic iron. The laterite of Beder is found on granite, and hot springs, and hills capped with trap, are found not far off. Mr. Malcolmson did not believe that any organic remains had been found in the laterite. Mr. Cole says that there is no reason to doubt that the laterite is a mechanical deposit, composed of the *debris* of older rocks.

We proceed to notice his account of the mineral in the vicinity of Madras. The Red Hills and Gundy are the only localities in its immediate vicinity, where he was able to discover the laterite. Nearer than the spots alluded to no hillock arises to break the level uniformity of the plain, on which Madras and its widely scattered gardens are spread out. The Red Hills are situated eight miles north-west of Madras: they are mere undulating ground, scarcely of appreciable elevation above the surrounding country, the highest eminence not attaining a greater elevation than fifty or sixty feet above the level of the plain. The whole laterite formation occupies a triangular area of about fifty square miles, extending nearly ten miles to the westward of the gravel pits on each side. Mr. Cole has explored an area of this extensive part from three to four square miles. Line of bearing of undulations irregular; direction south-west to north-east.

"From these rising grounds the land descends to what is termed the *Lake*, which is bounded on three sides by the eminences described above, the waters (when there are any) being confined, on the greater portion of the eastern side, by an artificial embankment, or *Bund*, but for which there would be no lake at all, as the country descends on that side towards the sea, it is believed about two and a half feet per mile. To the north east a natural drain for the waters from the higher grounds existed, but it has been filled up, at the place of junction with the lake, by a dam and water sluice, after the manner of an ordinary tank, for the irrigation of the country. The old channel, however, remains, and the banks, in some places fifteen feet high, show the mineral structure of the spot. They are composed of a dark ferruginous stone, arranged in a stratiform manner, presenting seams or partings, two or more feet asunder, parallel to each other, and nearly horizontal. Vertical fissures intersect the seams at right angles, and thus produce prismatic masses of the rock, which give these natural walls something of the semblance of huge artificial masonry. On breaking into the interior of these masses, the rock is palpably a conglomerate. Nodules of various sizes are observed, imbedded in a clayey paste, which is very hard and tenacious. These nodules may be picked out, without much difficulty, when it evidently appears that they are water-worn pebbles, presenting considerable angularity of surface, yet still sufficiently rounded to indicate their having undergone attrition, most likely by the turbulence of an inundation, which bore them away from their original position as parts of a solid rock, and deposited them, in their present conglomerate form, with the mud which now agglutinates them.

The nodules are observed of all dimensions, from the size of a filbert, to masses a foot or more in diameter. Their fracture exhibits the structure of a coarse-grained sandstone, or grit, of a deep chocolate, or claret hue (No. 1).* This nodular sandstone is made up of fragments of quartz (some rounded, but for the most part angular), from a minute sand up to the size of a pea. Added to the quartz, there are occasionally found small masses of a white earth, like lithomarge, appearing to be felspar in a state of decomposition (No. 2). This is found in small nests, here and there; but I have no doubt that a good deal, minutely subdivided, went to form the paste which united the parts of this conglomerate together. Thirdly, mica is found a constituent of these sandstone nodules, in very minute scattered leaves.

This sandstone precisely resembles the specimen from Puddayaram, near Samulcottah, in the Northern Circars, deposited in the Mineralogical Cabinet of the Madras Literary Society, by Dr. Benza, who has thus described its structure and relations in the

* The Numbers refer to specimens presented to the Society, in illustration of the Paper.

above locality. "The ferruginous sandstone is the lowermost, and has a great degree of compactness, so as to fit it for architectural purposes, in which it seems to be largely employed. It is evidently stratified, the strata being nearly horizontal; the quartz particles are agglutinated by a ferruginous cement.

" The sandstone, nearly in the whole extent of the hillock, supports a lithomarge of a whitish or flesh colour, sometimes having a bluish tint. The stratum of this earth is not very thick, and in many places, it is overlaid by a purple red, compact, slaty, hæmatitic iron ore, which passes insensibly in the upper part into a cellular rock, full of tubular sinuosities, very much similar to the laterite. In some places this ore lies immediately over the sandstone, without the intermediate lithomarge."*

These three minerals, then, are plainly discoverable in these imbedded masses of conglomerate sandstone, but there is an argillo-ferruginous cement uniting the whole together. This cement gives the colour to the entire mass, which is of a purple-red hue, as mentioned above, and sometimes has a bluish tinge (No. 3). Frequently it presents varieties, being either finer or coarser grained (Nos. 4 and 5). The quartz is very abundant; the lithomargic earth scanty, and the mica is met with in small disseminated scales, " few and far between." The original sandstone rock, then, of which these nodules are fragments, must have resulted from the fracture and disintegration of some still more ancient crystallized rocks. The sandstone, thus formed, being, in its turn, disrupted, the fragments were tossed and rolled about by some aqueous catastrophe, until they became imbedded in this *laterite* (so called), or conglomerate rock which we now see. This view of the case, indicates violent disturbing forces, occurring at two distinct periods of time. Besides the sandstone, fragments of ochrey iron ore, to be hereafter mentioned, were found imbedded in the clay.

I was unable to trace the appearance of stratification elsewhere than in this nullah. The ground rises abruptly from its banks to the N. W., forming one of the eminences bounding the lake on that side, and the rock changes character from what I have described above, as occurring in the bed of the nullah. Instead of seeing merely the sandstone nodules imbedded in clay, we have a rock possessing the more characteristic qualities of laterite (No. 6). It is rendered cavernous by tortuous cavities, which penetrate it in all directions, sometimes filled with red or yellow ochraceous earth; sometimes with a white clay, like decomposed felspar; but frequently they are quite empty, which is caused, it appears to me, by water percolating from above, carrying with it the soft substance of these earths, the spaces they once filled being thus rendered void (No. 7).

This laterite still shows evident traces of the sandstone, described as found, in such large fragments, imbedded in the walls of the nullah; but the pieces are much rounded and comminuted, and are united together by a very compact, heterogeneous, kind of paste, composed apparently of the *debris* of the sandstone itself, of iron ores, and of the lithomargic earth. There is no mistaking the sandstone, which may be picked out, in pieces of the size of a walnut, from the centre of a mass of the laterite, and clearly shews the same structure as that of the nullah (No. 28).

Pebbles, of various kinds of crystallized rocks, are met imbedded in the hardest and most compact laterite. On the rising grounds to the north of the lake, I picked out fragments of white quartz rock, some pieces angular, others much rounded (No. 9); of very compact siliceous sandstone, of a red colour, so hard as to be broken difficultly with a heavy hammer (No. 10), and of a white, granular, friable, disintegrating sandstone (No. 11.). Added to these, a great profusion of fragments of ochrey iron ore, red and brown (Nos. 12 and 13), a good deal of it slaty (No. 14), are found imbedded in the less compact kind of laterite, and in the gravel. This ore, I think, contributes to form the more compact laterite, also, but it appears to have been more broken and subdivided, and is therefore not so easily traceable.

The laterite varies very much in appearance. Sometimes it is very hard, compact, and heavy, highly ferruginous, of a deep red colour, penetrated in all directions by the sinuosities containing the red and yellow and white earths. In this kind the red sandstone nodules are very distinguishable (No. 15). Some masses are nearly half composed of the white lithomargic earth, which renders it very crumbling (No. 16).

Other varieties exhibit a pisiform structure, numerous rounded pebbles being united together by a yellow clayey cement; this seems of recent origin (No. 17).

Again, in many superficial situations, it is a mere gravel, possessing very little coherence, and, apparently, formed from the *debris* of the laterite itself. The pebbles, composing this gravel, still exhibit the structure of the red conglomerate sandstone, and of the ochrey iron ore (Nos. 18 and 19).

Innumerable pebbles strew the face of the ground, in all directions, a great number of which, on fracture, display the structure of the nodular imbedded sandstone (No. 20). I should observe, that I no where saw this sandstone in any other form than that of fragments imbedded in the laterite, or detached thence, and undergoing another rolling process on the present surface of the ground.

Equally numerous are the scattered fragments of ochrey iron ore, described above. I no where found this substance as a vein, or in mass. It would seem probable that it existed in the original crystallized rocks; and that, under the watery disrupting influences, to which the whole ingredients of the formation

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* *Journal of the Asiatic Society of Bengal*, August 1835, p. 437.

have evidently been subjected, this ore was very much comminuted, and the more minute particles contributed the greater portion of the ferruginous paste, so characteristic of all the rocks around.

To the eastward of the lake, in the low grounds, masses of the laterite jut forth from the soil ; and no other description of rock is to be seen in any direction.

On Colonel Cullen's property, on the east side of the lake, a trench has recently been cut, ten or twelve feet deep, and thirty or forty feet long. The first five or six feet from the surface consist of a red clay, containing a few fragments of the red conglomerate sandstone, some nearly a foot in diamèter, and, here and there, a piece of the ochrey iron ore. The sub-stratum is a yellowish, tenacious clay, with no imbedded pebbles. An even line of demarcation distinctly divides these two deposits, which do not at all blend into each other.

At the south eastern corner, the nearest point of the laterite formation to Madras, there are numerous pits, where the rock is quarried to furnish material for the repair of the roads. After penetrating several feet of gravel, they come upon the solid laterite, which is broken up with a crow-bar, for which the employment of very great force is necessary, the mass being previously softened by the effusion of water. It no where is of the soft consistence of the laterite of Malabar, as described by Buchanan and Babington.

The laterite in this locality (No. 21) varies in no respect from that to the northward of the lake. It is all of the true compact kind, and I no where saw the large masses of conglomerate sandstone imbedded in the clay, witnessed in the nullah ; nor was there any appearance of stratification.

The same kinds of imbedded rock fragments were found also at this spot, with the following additions :

1st. Granite, composed of quartz, felspar, and mica : a single, small, angular fragment (No. 22). 2d. Sienite, or sienitic granite, composed of quartz, felspar, and hornblende; a large angular piece, in a disintegrating state (No. 23). 3d. A fine grained greenstone ; a large fragment (No. 24). These were found among the fragments, which the workmen had produced by their operations in the pits, and I cannot say whether they were derived from the gravel or the compact laterite.

I have met with no calcareous matter in the localities I have visited, though I made particular enquiries on this point, as Dr. Heyne mentions the existence of that mineral at the Red Hills.* I picked up a single fragment of botryoidal kankar, to the south of the lake, but no where found it *in situ*.

At the top of one of the lower eminences, imbedded in the gravel, about a foot and a half from the surface, I found fragments of a rude pottery, the composition of which is of the coarsest kind, being a dark green paste, containing numerous grains of quartz (No. 25). These fragments, thirty or forty in number, were irregularly disposed, some pieces being vertically placed, others horizontally, shewing a confused arrangement in the gravelly matrix. This circumstance proves the gravel to be of recent origin.

Dr. Benza informs me that fragments of pottery, of precisely similar composition, are found in the cairns on the Neilgherry Hills. It appears to me to resemble none of modern manufacture."

Mr. Cole confirms the opinion given by Mr. Malcolmson of the non-fossiliferous character of laterite, which he considers as sufficient proof of its volcanic origin, and he thinks that the existence of imbedded fragments of crystallized rocks by no means militates against the eruptive theory, as portions of the rocks traversed by the volcanic rent may be thrown out. As building material and for road making on the McAdam system of formation, Mr. Cole states that the laterite is of great value. We cannot conclude this review without expressing our opinion of Mr. Cole's ability and research, or acknowledging the great pleasure we have experienced in the perusal of his and Dr. Benza's valuable papers, to which we shall recur in our next.

Art. IV.—Cultivation of Cotton, By W. BRUCE, *Esq. Remarks on the culture of Cotton in the United States of America,* Capt. BASIL HALL'S *Travels. Remarks on the best method of cultivating New Orleans Cotton. Ibid. Regarding the cultivation of Cotton, Ibid. On the cultivation of Cotton in Central India, By Baboo* RADHAKANT DEB. *Observations on the culture of Cotton in the Doab and Bundlecund, By* W. VINCENT, *Esq. On the artificial production of new varieties of Cotton, By* H. PIDDINGTON, *Esq. On the method used in Cayenne to preserve the Cotton plant. On a specimen of Cotton gathered in the Boglepore district from a shrub in its wild state, by* F. HUNTER.

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* *Tracts on India, p.* 114.

Use of the Sawgin, by F. MACNAUGHTEN, *Esq. Cotton of Ava. Cotton of Cachar, by Capt.* S. FISHER. *On Cotton grown in Cuttack and its staple for spinning, by* M. T. WEEKES. *On the native Cotton produced in the Garrow Hills, by Capt.* A. BOGLE. *Report on specimens of Cotton reared by Col.* COOMBS, *at Palaveram. On the cultivation of Upland Georgia Cotton at Allahabad, by Mr.* W. HUGGINS. *On the cultivation of Pernambuco Cotton at Tavoy, by* W. MAINBY, *Esq. On the cultivation of Sea Island Cotton in the district of Cuttack. On Upland Georgia and Sea Island Cotton.—Transactions of the Agricultural & Horticultural Society of India—Vol.* 11. 1836.

(Continued from page 208.*)*

We now proceed to examine the articles noted in the heading. The first is from Mr. Bruce, for many years a resident in Persia, who, having noticed the mode of culture of the cotton plant, submits his observations to the attention of the Agricultural Society. From Mr. Bruce we learn that cotton is much cultivated throughout Persia from the shores of the Persian gulph to the Caspian sea. Cotton of the finest quality is produced in the low country along the gulph and nearest to the sea-shore. It appears that the plant lasts from twenty to thirty years; during this time the ground is often ploughed up and sown with wheat and barley. The quantity which the plant yields is considerable. The cultivation in the interior is annual, where, owing to irrigation, the produce is greater. Mr. Bruce is of opinion that the sea coast cotton is improved not only by its being grazed upon and thus manured, but also from its superfluous stalks being broken off, which preserves all the moisture to the roots which would otherwise be required to nourish the stalks; and thus leaves the root in a vigorous state to throw out fresh shoots at the proper season. It appears that sheep and goats are turned in to graze on the leaves and shoots after the cotton is picked, which improves the staple: after the cattle have left nothing but bare stalks, the poor women and children resort to them for fire-wood and break them close to the ground. When the season returns these stumps send out fine shoots which are soon covered with leaves; flowers follow, and the cotton becomes as luxuriant as ever. A great part of the soil is sandy, mixed more or less with shells and a small portion of loamy clay. Mr. Bruce represents that the sea air improves the cotton, making the staple firm and better. Nankeen cotton is extensively cultivated and manufactured in a very decent sort of nankeen.

Baboo Radhakant Deb alludes to the method of cultivating cotton in the central districts of Hindustan. The superior cotton is called "Banga," of which there are three kinds, the 1st Bhagella, 2nd Bhochurry, and the 3rd Pokhy. The culture commences in the month of Assur; when the sun enters the sign of Gemini, a quantity of seeds is intermixed with cow dung and exposed to the solar rays to dry; when moderately dried, they are sown upon a light soil kept in preparation for the purpose, and freed from weeds. Our author states that it is a singular custom of cultivators to taste the soils in order to distinguish the saccharine from the saline or nitrous, the chalky, and insipid soils. The saccharine soil is deemed the fittest for the culture of the best Indian cotton. It appears, by this writer's account, that the cultivators follow the ancient mode of distinguishing seasons by the solar transits, or by the sun's entering the various signs of the zodiac, as well as by marking the changes which are most commonly influential within every twelve years, or those attributed to the revolution of the planet Jupiter, which is also known to operate upon the seasons. It appears that the seeds sown in the manner before mentioned soon give shoots, which run up to the height of a span; the soil is then opened and weeded with a small instrument called the native weeding-hook. In the month of Maug, when the sun enters the sign of Capricornus, the plants will have arrived to maturity. In this month the ground is dug up with hoes or ploughed; and as nu-

merous small scions are formed in the plants, they are plucked off, which expedient directs the sap to the productive branches and gives a better crop. In the month of Choyte, when the sun enters Pisces, the pods are formed, which are allowed to become fully ripe; and, having at this period a gradual increasing solar heat, they burst and exhibit the wool in the fulness of bloom. The gathering continues until the month of Joistee. It is then threshed with an instrument in the form of a double reel, which winds adversely and throws out the seeds: it is then worked with a wired instrument called "dhuvee" which fits it for sale. The produce may be estimated at about one maund of cotton in each beegah of the first crop. The price of the first sort is ten rupees; second, eight; third, six rupees per maund. In the western provinces our author states that the produce is more abundant from the peculiar adaptation of the soil and climate: constant rain or two much moisture in the soil he states to be unfavorable to the growth of the plants which, in such situation, were destroyed by a species of vermin. Saline moisture or superabundance of putrescent matter, heavy dews or frost, are also deemed unfavorable.

Mr. Vincent, speaking of the culture of cotton in the Doab and Bundlecund, states that it is sown on almost all descriptions of soil, but chiefly in the richest lands from which, in the months of March and April preceding, the wheat and barley crops have been cut. The land is well manured preceding the rains, and is in general sown immediately after the first heavy showers at the end of June or beginning of July, at the rate of $4\frac{1}{2}$ and 5 seers of seed per biggah of 160 feet square; irrigation is seldom necessary, and never before the end of September or beginning of October. The plant is weeded three times, and in the best lands rises to the height of 4 and 5 feet; in inferior lands to 2 and 3 feet only. The pods are plucked when they begin to burst, which commences in October and lasts until November. The cotton first plucked is represented as being the best; the cultivators make no difference, but mix all together; an information which is of great importance; for may not this neglect of selecting the first crop be one reason for the India cotton brought to market being of an inferior quality. Mr. Vincent states that the produce of a biggah is on an average about a maund of cotton. A specimen of cotton, gathered in the Boglepore district from a shrub in its wild state, was presented to the Agricultural Society by Mr. Hunter: it was of a superior kind and afforded a strong proof that the soil and climate of Boglepore in Behar is well suited to the cotton plant.

The following communication on the growth of cotton in Ava is of too great importance to admit of being abbreviated.

"The Burmese, it is well known, cultivate cotton very extensively, and the larger portion of the produce is exported; conveyed to China by the inland routes, and to Arracan and the districts of Chittagong and Dacca, either overland, by the two passes of An or Aeng, and Talak or Dalet, or by sea, from Bassein round Cape Negrais.

Two British merchants, Messrs. Laird and Gouger, who had both resided for some time at this Capital, when examined by Mr. Crawfurd at the close of the war, gave him the following information respecting the probable quantity of cotton annually exported from this country. Mr. Laird considered that the quantity exported from Ava to China annually, could not be less than 70,000 Bengal bales of 300 lbs. each; that is. 21,000,000 lbs.; and Mr. Gouger estimated the quantity annually taken to Dacca by Burmese boats, to be about 20,000 bales of 100 viss or 360 lbs. each, that is, 7,200,000 lbs. See Appendix to Crawfurd's Mission to Ava, pp. 44 and 75.

I am of opinion, that Mr. Laird's estimate of the quantity exported to China is far too high, although my enquiries from the Burmese themselves would go rather to confirm its accuracy. At my request Mr. Lane, an English merchant now residing here, privately applied to the Clerk or Collector, who levies the export duty of 3 ticals per 100* viss on cotton conveyed to China, and received the following statement of the quantity on which duty was actually levied during the year 1830, at the two Chinese marts, Madè and Ban-mau pronounced Bamau.

At Made........	3,600,000 viss, or,	12,960,000 lbs.
At Ban-mau ...	6,700,000 do or,	24,120,000 do.
Total	10,300,000 viss, or,	37,080,000 lbs.

The number of boats-load of cotton annually taken to Madè and Ban-mau was declared, by the same person, to amount to 1400; and he estimated the exports from the Shan countries to China at 1,200,000 viss, or 4,320,000 lbs.

Equal to about $12\frac{3}{4}$ annas per maund, or $7\frac{1}{3}$ p. cent. *ad valorem*.

The above statement affords a striking proof of the very great difficulty of obtaining in this country any accurate information on questions of statistics. I am convinced that the Burmese clerk has added a cipher in each of the above sums. Cotton is taken from Madè to China on mules and ponies, each having a load of only 50 viss, as I ascertained on the spot. At this rate, to convey 3,600,000 viss would require the extravagant number of 72,000 of these animals ! My enquiries at Madè assured me, that the whole of the Chinese traders this year did not exceed 5000, and as some of them make two or three trips in the season, I should think that 7200 loads of cotton, or 360,000 viss, would be just about the quantity conveyed from Madè. Besides, all the cotton boats, which are remarkable objects on the river, pass close to my house, and I am positive, that the number during the past year has been nothing like 1400. Those which proceeded to Madè, between December and April, conveyed each about 100 bales, or rather large baskets containing 100 viss each, and I should not estimate the number which passed, at more than from 30 to 40. Those which transport cotton to Ban-mau, proceed at all seasons of the year, but they are less heavily laden than the boats which go to Madè, carrying not more than 60 baskets of 100 viss each; and 110 boats would be as many as I would allow to have passed to Ban-mau during the year. Captain Cox was informed in 1797, that the number of these cotton boats was from 100 to 160, each carrying 10,000 viss, and the average amount of sale of the cotton 600,000 ticals.

With respect to the quantity taken to Arracan by the route of Aeng, we have the information collected by Captain M. G. White, Principal Assistant to the Superintendent of Arracan, in a report made by him after visiting Aeng in April last year, that the number of bullocks which went to Arracan from Ava during the preceding year, amounted to 20,000, each carrying a load of two Bengal maunds ; but as much cutch, stick lac, and other articles are taken to Arracan (the Chinese caravans export scarcely any thing but cotton), we cannot perhaps allow that more than one-half of this number of bullocks conveyed cotton. Perhaps one thousand more bullock-loads, however, were taken by the less frequented route of Talak ; and this would give an amount of 22,000 maunds, or, 1,804,000 lbs. exported to Arracan overland. If a similar quantity be allowed for the exports by sea, the whole amount would be 3,608,000 lbs. which would still be far from Mr. Gouger's estimate. But I have no means of ascertaining the amount of the exports by sea, to which mode of conveyance alone Mr. Gouger's estimate appears to be limited. I can only observe, that, allowing the boats from Bassein to take 60 bales, or 21,600 lbs. each, it would require 83 large boats to convey the 1,804,000 lbs. which I allow to be exported by that route. Captain Cox reported the number of boats, that traded in his time between the Southern Burmese ports and Luckipore, Dacca, &c. proceeding by the way of Bassein, not to exceed 42 very large boats, and the value of their cargoes, exclusive of specie, 20,000 ticals only. But Mr. Gibson estimated the number of boats which annually go from Lamina, a town on the Irawaddy above Bassein, to Arracan and Bengal to exceed 1,000. Following my estimate, the exports of cotton from this country would not be more than as follows :

From Madè to China,...... lbs.	1,296,000
From Ban-mau to ditto,....	2,412,000
To Arracan, Chittagong, &c. viâ Aeng, ...	1,640,000
To ditto viâ Talek,..........	164,000
To ditto by boats,..........	1,804,000
Total lbs.	7,316,000

The ponies and mules of the Chinese caravans, which are very poor, miserable animals, do not carry much heavier loads than the bullocks which travel to Arracan. The latter carry 2 Bengal maunds, or about 164 lbs. and the former 50 viss or 180 lbs.; but the Chinese traders have an ingenious mode of compressing the cotton into a small compass,* by forcing it into pits dug in the earth of the size and shape required to fit the back of their ponies and mules. Over the pit is placed a mat which is forced down with the cotton, and serves to pack it. Both Colonel Symes and Captain Cox mention that the Nankeen cotton is carried to China ; but saw no other than the white at Madè, or in any of the boats which have passed my house, and I am assured, that that description alone is taken to China. It is used there, the Burmese say, almost entirely for quilting. In the time of those officers also, Tsa gain, opposite to Ava, seems to have been the great mart for cotton. At present, however, a small village about two miles below Ava, and on the same side of the Irawaddy, called, Lettshoung-yoo, is the spot where the cotton is generally collected, packed into baskets and shipped in the large Burmese boats, which convey it to Madè and Ban-mau.

Messrs. Gouger and Laird informed Mr. Crawfurd, that the Burmese cotton was conveyed to Dacca, to be used in the manufacture of the fine Dacca muslins. This same information was given to me by all traders in this country ; but it would be worth ascertaining at Dacca, if such is really the fact, for I observe that lately in England, a good deal of enquiry has been made, without any one being able to answer it, as to the particular cotton of which the fine Dacca muslins are manufactured. (See Minutes of Evidence before the Committee of Evidence, before the Committee of the House of Lords on East India Company's Affairs, part 10, Question 4729 to 4750.) Bishop Heber, in his journal, states from Dacca, that " the cotton produced in this district is mostly sent to England raw." (Octavo Edition, vol. I. page 285), and Walter Hamilton, in his description of Hindoostan, Quarto, vol. I.

* Neither the Chinese here nor the Burmese have any Cotton screws.

pp. 182 and 184, states under the head of Dacca, that a considerable proportion of the cotton is raised in the adjacent country, but a great deal is also received by the course of the Ganges from Patna and Upper Hindoostan; and that "in this district a species of cotton, named the *banga*, grows, necessary, although not of a very superior quality, to form the stripes of the finest muslins."

The Burmese cultivate cotton in almost every part of their country, but the largest quantity is grown in the districts lying between Ava and Prome. It is *not* grown as a second crop after the cultivation of rice, but in distinct lands. The seed is sown about the same time with the paddy, in the beginning of the rains, in the months of Katshoun and Wagoung, our April and May, and the cotton is gathered in Tha-dengy-wot and Ta-tshoun-moun, our October and November. The seed is sown *broad cast*, after being well washed with water, and the ground is weeded three times before the plants attain the height of three feet. A scanty second crop is sometimes gathered in the months of Tahoung and Tagoo, our March and April, before the plants arc cut down, and the ground prepared for fresh sowing. Frequently, at the same time with the cotton, brinjalls and other esculent vegetables are sown; the seeds of the two are mixed, and thrown on the ground together.

The Burmese know only the annual plant. The Nankeen, called *Wa-nee*, or red cotton, is often grown in the same fields with the white; and some cultivators assured me at first, that the seeds of the two are precisely the same, and that they cannot tell which description of cotton will be produced, until the flower appears. But upon further enquiry I find, that the seeds are mixed by the women and others employed in cleaning the cotton, and that no trouble is taken to separate or keep the two distinct, by which means the mixed seed is usually planted. A careful enquiry would enable the planter to discover from the small portion of cotton adhering to each seed, whether it belongs to the white or Nankeen species; but this would give too much trouble to a Burmah. No manure is used, and the plants sometimes grow up as near as three and four inches from each other, according to the spot where the seed fell when sown in this slovenly manner.

The red cotton is used by the Burmese to manufacture a description of cloths of which the women, particularly in the country, make their jackets. It is called *Phyen-nee* or *Pen-nee*, and does not require frequent washing, a great recommendation here. The *Myè-lat* or middle ground Shans, those situated in the country between Ava proper and the Saluen (Dr. Buchanan's *Mre-lap*), cultivate more of the Nankeen cotton, and manufacture a better kind of *Phyen-nee*, which they annually bring for sale to Ava. It is in pieces of 60 cubits long and 1½ cubits wide, which sells for 7 ticals, or 9 rupees 12 annas. The Burmese *Phyen-nee* is often made of the white cotton and dyed. I send herewith two small samples of the Burmese and Shan *Phyen-nee* cloth.

The Burmese call the dressed or cleared cotton *Gwon*, and the undressed *Wa*. It is cleared from the seeds in the same manner as in Siam, by a simple machine called *Kyait* or *Gyait*, consisting of two cylinders revolving close to each other, and moved by a handle. The cotton is drawn between them, leaving the seeds in the hand which feeds the machine. There is a large description also of this machine with iron cylinders, called *Than gyait*, and moved, in addition to the handle, by a wheel and the foot, in the same manner as a knife grinder's engine. The bow, like that of India, is afterwards used, still further to clean the cotton when it is required for spinning; but the cotton, which is exported, has the seed only removed. The person who separates the seed can, it is said, prepare 10 viss or 36 lbs. of clean cotton per diem, and his usual hire is 2 moas or 3½ annas per diem. 300 viss of undressed cotton yields 100 of cleaned cotton. The price of cotton fluctuates from ten to fifteen ticals for the undressed, and from thirty to fifty ticals for the cleaned cotton: which last, however, has sometimes been so high as 80 ticals per 100 viss. But the average price of 40 ticals per 100 viss, will be about 10 rupees 14 annas per Bengal maund; and I observe, from a Calcutta price current for last month, that the highest priced cotton, then at Calcutta, was 12 rupees per Bengal maund. Captain White mentions, that at Aeng the traders told him that they purchased the cotton for 30 ticals per 100 viss, and that they can sell it there for 65 rupees. They buy the cotton directly from the planter, and can probably get it cheaper than what it sells for here.

The Nankeen cotton is often mixed with the white from the manner before described, in which the two are planted; and, to get a quantity of Nankeen cotton only, a higher price is usually paid for the trouble of separating it entirely from the white. Few plant the Nankeen cotton only. I have sent down to Captain Rawlinson at Rangoon, to be forwarded as samples to Calcutta, 10 viss of each description of cotton. It appears to me not particularly long in the staple, but very fine and silky, and so I understand it is considered by competent judges. The white cotton I have sent, is the produce of Mendoun, a district on the frontier of Arracan, in which territory also it might perhaps be extensively cultivated. The red cotton is from a place called *Tharet* or *Thayit* on the western banks of the Irawaddy near Madè (Wood's Sirraip Mess).

The cotton of the Martaban province, called lately the Tennasserim cotton, appears to me to have a much longer staple than that of Ava, and so does that I saw at Bankok brought from Menan-noi on the frontiers of Tavoy. The Karens are the cultivators of cotton in the Moulmein province, and their plantations are always, I believe, on alluvial soil, on

banks of the rivers, or on islands in them, overflown during the height of the rainy season. This seems to be the same description of soil as that on which the Sea Island cotton of America is grown.*

The Burmese use the cotton seed extensively for lights, particularly in the open air, at their dances and entertainments. Two or three lbs. of the seed with some earth oil are put into a vessel, usually a broken cooking pot, and when lighted they give for several hours a good large flame.

We have no space to continue the subject in our present number, but shall resume it in our next.

Art. V.—Bell's Comparative View of the External Commerce of Bengal, during the years 1834-35, *and* 1835-36, *accompanied with tables, illustrative of the extent of trade carried on with each country and state, by* JOHN BELL, *Superintendent of Inspectors, &c. Royal Octavo, pp.* 106, 1836. BAPTIST MISSION PRESS.

Works of this nature are seldom examined by readers beyond the mercantile sphere; but when we reflect that the country which gave the British sojourner birth owes her opulence and grandeur, her improvements in arts and knowledge, the great bulk of her comforts and convenience, to the instrumentality of commerce alone, some enquiry into its causes and resources is not unworthy the attention of the man of science. That we may escape the charge of imparting an erroneous view in laying down the foregoing proposition, we would advert simply to one of the most interesting works that can be perused and which is devoted to this subject we mean that celebrated work; "on the Historical and Chronological Deduction of the Origin of Commerce." Vast and various are the subjects which are connected with commerce, comprehending discoveries, inventions, improvements, navigation, colonization, manufactures, agriculture, as well as their relative arts and sciences. Although we do not anticipate so great a feast in Mr. Bell's Comparative View of the External Commerce of Bengal, still we take up his work, with the conviction that nothing less than the instrumentality of commerce can enrich British India. Those things which are useful and excellent in nature or art, especially for intellectual gratifications, for comfort convenience, or the elegance of life, it must be acknowledged, are principally derived from commerce, either primarily or mediately. It is profitable therefore to convey to our readers those notices and instructions on commercial questions which are connected with this country. Mr. Bell's work appears annually. He congratulates the mercantile community on a remarkable extension of trade and important fiscal alterations which have been effected since his last annual. He places the laurel on the brow of the Honourable Mr. Ross for the bold measure of releasing the upper provinces from the thraldom to which the country was rendered subservient by the mischievous effects of the transit system, and which "was only surpassed by the act for their subsequent abolition under this presidency, followed, as that step was, by the downfall of the town duties." The foregoing is a degree of praise altogether misplaced. We are ready to give Mr. Bell due credit for the sincerity of his feelings; but we can assure him that it required no boldness on the part of Mr. Ross to do what he did; nor was it any great merit on that of the Supreme Government to follow up what the Hon'ble the Governor of Agra had commenced, and which the home authorities had more than once expressed their desire to see effected. In a letter to the Governor General dated 10th June 1829, the court observe, "with respect to the transit or inland duties on commerce, you are not unapprized of the weight we have long attached to the objections against them." The court considered it so complex and burthensome a system that in a letter dated January 1830, they again direct attention to the propriety of abolishing all internal duties under whatever name collected: they declare "*we hardly* anticipate any possible objections on your part." Under this view of the state

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* The finest tobacco in Ava is cultivated at a place called Nga-myo-gyee, a little above Yandaboo, on islands and on the bank of the Irawaddy, on ground always overflown during the rainy season.

of the question we are inclined to reverse our author's opinion, and suppose a boldness had the Supreme and other Governments any longer withstood the court's express orders on the subject. This reminds us of the local Government withholding all patronage from Oriental literature : it might as well be said that it would be boldness in the local Government to renew the support notwithstanding positive injunction; quite contrary is the case; as we have fully proved in the first number of our review. If we may judge from official documents, the local Governments have, for years past, been in a great measure the conservators of systems of extraordinary economy, the policy of which is now about to be proved as injurious to the prosperity of the resources of the country, as it has been burthensome and oppressive to the people. Mr. Bell next alludes to the mild and considerate foundation on which the new tariff is erected, evincing a policy at once, he says, liberal, and judicious;—liberal as regards the interests of the merchant, and judicious as relates to the future welfare of the State and happiness of the people. He is in anticipation, which we earnestly hope may be realized, that when the plan is matured and extended, it will secure to the honest trader protection, and secure the Government against loss by smuggling. If any good does result, much will be ascribable to our author, who is the able and zealous superintendent of inspectors, and who, on so many occasions, whether as secretary to the Agricultural Society, or in other lesser offices which he fills, has proved himself to have the interest of Government and the governed at heart, and to be an indefatigable labourer in promoting not only the commercial but the agricultural interests of India. We are glad to see our author taking the right view of the question. If unshackled intercourse throughout India will more than compensate eventually for the deficit which may at first be felt in the accustomed receipts. Mr. Bell very properly calls the attention of the Government to the melioration of the agricultural resources of the country, and shews the mercantile community that agricultural improvements are as closely connected with their interests. Numerous have been the causes which have tended to depress the agricultural prosperity of India ; but we are satisfied that the strenuous exertions of the numerous agricultural societies in all parts of the country will work an important change, and that decided improvement of our agricultural resources will ere long begin to appear on the general condition of the trade. Mr. Bell opens his "review" with the following.

"We introduced our remarks in 1834-35—by a comparative abstract of the trade in that and the preceding year, which gave a very favourable result.

We showed that on the official value of merchandize imported, increase had taken place to the extent of Sa. Rs. 18,48,956—and on merchandize exported, to the extent of Sa. Rs. 14,22,477—or a total increase of Sa. Rs. 32,71,433.

On Imports of Bullion and Specie,—the excess was Sa. Rs. 7,04,794½—while, on Exports, the decrease was Sa. Rs. 19,95,541—leaving a Net Deficiency under this head, of Sa. Rs. 12,90,746½.

We further showed, that this surplus of Private Trade in Merchandize had overbalanced the decline of the Honorable Company's Exports, by Sa. Rs. 2,58,278

This improvement, in the amount of Trade, comprehending, as it did, a large proportion of merchandize, wholly free on importation, as on produce exported (free in regard to Sea Duty)—under protection of Rowannahs, did not exhibit so favourable a contrast in regard to Revenue; the increase of Duty on Imports, being only 14,857 Rs. and on Exports 93,753 Rs.

It is gratifying to follow up this statement by one in the present year, still more productive, as follows :

Private Trade Merchandize.	
Increase on the official value of Imports,........	31,32,896
Increase on the official value of Exports,.................	1,51,21,084
Making a Total of,........	1,82,53,980
Bullion and Specie.	
Increase on amount value Imported,..	4,15,946
Decrease on amount value Exported,............	43,194
Net Increase,........	3,72,752

Total Increase in Merch. and Treasure in 1835-6, Sa. Rs. 1,86,26,732

The above does not include the Honorable Company's Trade, the falling off in which (Merchandize) amounts to 13,33,405 Rs. but if we give Private Trade credit for this displacement, there is yet an excess on Exports of Produce to the extent of 1,37,87,679 Rs.

The collections of duty have been as follows:

On Imports, Increase,......		9,25,535½
On Exports, Increase,......		85,921
Total Increase,.....	Sa. Rs.	10,11,456½

IMPORTS.

In regard to the augmentation which has taken place on Imports of Merchandize and Treasure, the following countries and places have contributed to the extent noted against each—viz :

Great Britain, Sa. Rs. 22,92,319 ½—Antwerp, Sa. Rs. 462—South America, Sa. Rs. 1,48,358½—North America, Sa. Rs. 7,49,516—Maldives and Laccadives, Sa. Rs. 11,582—Bombay and Malabar, Sa. Rs. 9,36, 978—Arabian and Persian Gulphs, Sa. Rs. 1,43,314½—Penang and Malacca Sa. Rs. 1,98, 669½—Sumatra and Java, Sa. Rs. 42,867½—Pegu, Sa. Rs. 1,45,222½—Bourbon, Sa. Rs. 3,08,378.

The aggregate of the sums has been reduced to the Net Amount exhibited in the foregoing statement, by Decrease on Imports from France, Sa. Rs. 1,244—Madras and Coast, Sa. Rs. 94,945—Ceylon, Sa. Rs. 58, 944—Singapore, Sa. Rs. 5,99,599— China, Sa. Rs. 5,52,780—New Holland, Sa. Rs. 7,121—Mauritius, Sa. Rs. 1,14,061—and Cape, Sa. Rs. 132.

EXPORTS.

The great Increase in the amount value of Exports is made up as follows :—

On Trade to Great Britain, Sa. Rs. 42,79,261 ½—France, Sa. Rs.9,58,565—Denmark, Sa. Rs. 56,492—North America, Sa. Rs. 23,97,791—Maldives and Laccadives, Sa. Rs. 18,547—Arabian and Persian Gulphs, Sa. Rs. 4,22,188—Penang and Malacca, Sa. Rs. 2,38,919—China, Sa. Rs. 77,36,890—Sumatra and Java, Sa. Rs. 1,27,082—Pegu, 2,91,848½—Bourbon, Sa. Rs. 87,535—reduced to the Net sum above stated, by Decrease on Exports to Madras and Coast, Sa. Rs. 2,28,465—Ceylon, Sa. Rs. 49,829—Bombay and Malabar, Sa. Rs. 5,34,204—Singapore, Sa. Rs. 49,399—New Holland, Sa. Rs. 34,704—Mauritius, Sa. Rs. 6,06,566—Cape of Good Hope, Sa. Rs. 34,062.

Having pointed out the countries that have contributed to this improvement, the next question which naturally presents itself to the general enquirer is, upon what articles has this increase taken place?

It is not essential to enter minutely into details, for to such of our readers as study this book for commercial information only, the tabular statements exhibit the best guide; but there are others who soar above the drudgery of particulars, and who, although equally interested in the well-being of our external commerce, have not time at their command, and are glad to arrive at general conclusions, without more trouble than scanning general results.

The Net Increase on Merchandize Imported, during the last year, compared with the value of goods in 1834-5, has been stated at 31,32,896 Rupees.

Dropping odd thousands therefore, and noticing only important increase, the articles upon which augmentation has taken place, and the extent of that increase, are

Salt, (Paying Duty,)	about	11 lakhs	increase.
Cotton Twist,......	,,	7½	ditto.
Haberdashery and Hosiery,........	,,	2	ditto.
Copper,............	,,	3½	ditto.
Iron,............	,,	4½	ditto.
Spelter,............	,,	2½	ditto.
Lead,............	,,	1¼	ditto.
Steel,............	,,	½	ditto.
Brandy,............	,,	1½	ditto.
Port, Claret, and Champaigne,.........	,,	2	ditto.
Beer,............	,,	¾	ditto.
Betel Nut,............	,,	1½	ditto.
Beads,............	,,	¾	ditto.
Coffee,............	,,	½	ditto.
Cocoanuts and Kernels,............	,,	1	ditto.
Paints,............	,,	½	ditto.
Stick Lac,............	,,	½	ditto.
Teak Timber,.........	,,	1	ditto.
	Say,	42¾	lakhs.

Against this sum we must place those articles on which serious decrease had taken place, viz.

Woollens,..........	about	5 lakhs	decrease.
Cotton Piece Goods,	,,	1¼	ditto.
Silk Pieces Goods,.	,,	1¼	ditto.
Pepper,..........	,,	2¼	ditto.
Tea,..........	,,	2	ditto.
Block Tin,..........	,,	1½	ditto.
Vermilion,..........	,,	1	ditto.
Alum,..........	,,	½	ditto.
Segars,..........	,,	½	ditto.
Sherry,..........	,,	½	ditto.
Lametta,..........	,,	½	ditto.
Chanks and Cowries,	,,	½	ditto.
	Say,	17¾	lakhs.

This leaves an excess of 35 lakhs, the difference between which and the Net Increase already shown, being made up of increase and decrease below half a lakh, on other articles, as given in the Table of "Imports General."

(To be continued.)

Art. VI.—Cursory notes on the Isle of France, made in 1827*; with a map of the Island: by* E. STIRLING ESQ., *Member of the Asiatic Society,* 1833. *Calcutta.* THACKER & CO. 8*vo. pp.* 50.

The work we are about to examine has been published three years ago: there are numerous persons now in India to whom it is unknown. The subject of which it treats is of great interest, especially to those who, from loss of health, may hereafter bend their way to the isle of France, in the hope of its

restoration. Our author quitted the Sand-heads on the 1st September and reached the sland on the 4th of October. He experienced rough weather nearly the whole way; and, in consequence of the ship having been loaded with rice, the cabins were sufficiently offensive and warm to render the voyage disagreeable. Our author doubtless looked upon it with disgust. He makes no mention of it, but brings us at once to the heart-stirring animating report after a month at sea of land in sight. The lofty hills of the island and the high land of two or three small isles on its north were seen at a distance of forty miles: early in the morning he reached Bill Bay at the entrance of the harbour. Our author does not attempt to amuse the reader with any attempt at the description of the scene on his arrival; but enters at once upon a geographical and statistical description of the place.

" According to the measurement of Abbé de la Caille, the island is about thirty-three miles long and twenty-one miles broad, in its extreme points of distance. Its form is not unlike a triangle, reckoning its southern shore to be the base, and its face on the west and east, its two remaining sides. The circumference of it was ascertained by the Abbé de la Caille to be 93 miles. The above estimate and measurement I believe to be pretty correct, and suffciently accurate for all geographical purposes. From the sea, the island presents little more than a group of lofty and inaccessible mountains, having the most irregular shaped summits, and peaks exhibiting numerous isolated eminences either pyramidical or in the form of ill-shaped pillars. The Petre-botte and the Pouce are conspicuous above the rest for their singularly elevated pillared tops; judging these as the centre around which the other hills are congregated, they may be considered as the highest in the island. They are both nearly of the same height; the former is reckoned 420 fathoms, or 2520 feet high from the level of the sea. A table of the heights of the different mountains, and the situation of the chief points of the island, is subjoined, extracted from Grant's History of the Mauritius, being the result of observations made by the Abbé de la Caille."

Table of the Geographical Positions of the most remarkable Points in the Isle of France, with the Height of its Mountains above the level of the Sea, according to the Geometrical operations of the Abbé De La Caille, made in the Year 1753.

	South Latitude.	*East Longitude from London.*	*Height above the sea, in fathoms.*
	°	° ″ ′	
Summit of the Isle of Serpents, called Parasol or small round Isle,	19 48 55	57 46 10	83
Summit of the Great Round Isle,	19 50 34	57 45 6	165
Summit of le Coin de Mire,	19 56 12	57 34 37	81
Point of Cannoniers,	19 59 50	57 30 49	
East point of the great Isle d'Ambre,	20 2 9	57 40 28	
Point of Rocke,	20 2 39	57 29 13	
Foot of the flag-staff on the first discovery of Ships,	20 6 44	57 35 14	134
Foot of the flag-staff of the Long Mountain,	20 7 56	57 29 51	89
Front of the New Church of Port Louis,	20 9 45	57 28 0	
Point of Flac,	20 9 49	57 44 5	
Foot of the flag-staff at the opening of Port Louis,	20 10 8	57 27 10	166
Summit of the Mountain called Petrebotte,	20 11 21	57 30 48	420
Summit of the Rock called Le Pouce,	20 11 40	57 29 25	416
Point of the entrance of the Small River,	20 12 49	57 21 14	
Summit of the Piton de la Tayence.	20 14 28	57 39 13	223
Summit of the Mountain of the Corps de Garde,	20 15 22	57 26 48	369
Point of the middle of the Isle,	20 17 9	57 33 10	302
The Isle Rocheat, at water level, at the entrance of E. channel, P. Bourbon,	20 17 26	57 47 8	
Summit of the Mountain Du Rampart,	20 18 2	57 23 23	396
The highest point of the Three Mamelles,	20 18 28	57 24 42	342
Summit of the Mountain of Bamboo,	20 18 57	57 42 46	322
Summit of the Mountain of the little Black River,	20 20 40	57 20 13	286
Summit of the Mountain of Port Bourbon,	20 21 29	57 41 14	249
Flag-staff of Port Bourbon,	20 22 20	57 41 9	
Middle of Isle Marie Anne,	20 22 34	57 45 3	
Middle of the Isle du Passage,	20 23 44	57 43 51	
Point of the Mountain of the little Black River,	20 24 18	57 22 7	424
Summit of the Mountain of the port,	20 26 50	57 19 27	309
Summit of the Morn du Brabant,	20 27 I	57 17 1I	283
Summit of the Mountain de le Savanne,	20 27 2	57 27 30	355
South-east point of the Isle,	20 27 50	57 16 8	

Mr. Stirling next turns to the nature of the soil. Unacquainted with the exact quantity of arable land, he concludes that all the land which is fit for cultivation has been made arable by clearing away and cutting down the trees. The expenses of clearing are very considerable. The land Mr. Stirling saw being cleared was covered with trees whose roots appeared to be in possession of the whole of the sub-surface, and stems or stumps, after the trees had been cut down, occupied, two or three feet from each other, the surface above ground. The brush-wood had been burnt, but the large trees were strewed indiscriminately about the field which was being prepared. It appears that much labour was employed, and that the expenses were considerable. Such was the profit resulting from the service of clearing the land and appropriating it for agricultural purposes. Our author conceives that the quantity of land in cultivation is six thousand English acres: the quantity of arable land at present amounts, by the French measurement, to a little short of fifty thousand, or about six thousand acres more than reckoned by the Abbè de la Caille eighty years ago. We submit the following as worthy the attention of the authorities here.

"Lands were originally granted to individuals in small untilled and unreclaimed portions, to be cleared and brought into cultivation, with a certain number of slaves, to be paid for from the produce of the ground, at a distant date, when the means were afforded by the advancement of the tillage, so that settlers were enabled to cut down the wood, cultivate the ground, and build houses, mills, &c. &c. According to the instructions given by the East India Company, dated 24th May 1761, to the Governor of the Isle of France, they recommend the division of lands into small parcels, among such as chose to become planters, and to let each follow the bent of his genius, whether it be for tilling corn, breeding horses, bullocks, poultry, planting cotton or coffee trees: but to afford facilities for shipping, and to reduce the price of labour, they particularly recommend the breeding carriage and draught beasts of small kinds. On these conditions, joined apparently with that of military service of a slight nature, lands were distributed to all those who resorted from the mother-country to realize an independence."

Talking of the food for cattle, our author states that the forests and hills, during three or four months in the year, supply an abundance of food for cattle. There are three species of grass, which Mr. Stirling believes to be of the genera denominated the Cynosarus, the Festice, and the Bromas. It is remarkable, notwithstanding a plentiful supply of forage, that cattle do not thrive in the island: bullocks, mules, and asses are in consequence imported from foreign countries. On the subject of manufactures and public works we have the following.

"A country that furnishes nothing but its colonial produce, when there are a number of inhabitants who are unconnected with the proprietors of the soil, would be expected to manufacture articles to a considerable extent for its own consumption, or to augment by their labour the value of foreign importations; and acccording as attention to this subject was manifested, we should be inclined to acknowledge their industry. It may be stated, that the Isle of France produces at present nothing but colonial produce for exportation. The manufactories of sugar are no doubt very great, and the number of mills for producing it, since the last regulation of parliament in its favor, have been increased very considerably. There are probably not less than forty sugar-mills at work during the season. I have heard one hundied and fifty, but this appears to exceed the proportion due to the produce. Rum is also manufactured, but I am ignorant of any data on which to estimate its quantity. Ship-building is carried on to a limited extent, but the high price of labour and timber prevent it being undertaken except under favorable circumstances. The boats that are employed on the coast of the island are all made here. Carts and waggons are likewise manufactured for the use of the colony."

There is no nation in the world excelling the French in the promotion of science and arts. The administration of M. Bourdonnois is favourably spoken of.

"The French during their administration deserve much praise for the many improvements they effected, which tended greatly to the advancement of the interests of the proprietors, and those of the government. The indefatigable exertions of M. Bourdonnois, for the attainment of these objects, excites a certain degree of astonishment, when we remember the innumerable difficulties this laborious Governor had to surmount, in bringing this island into a state of cultivation; in overcoming the torpid indolence of the colonist; in forming a militia; in making roads, bridges, aqueducts, hospitals, piers, and dock-yards, forming harbours for the shipping, and in providing for the defence of the island, by constructing fortifications and batteries in all commanding situations: and this astonishment is still more augmented when we view him, towards the end of his government, building vessels and embarking his soldiers for India, and, notwithstanding the great impediments that were put in his way, and the disasters he suffered in the voyage, manfully

coping with the English fleet, and making himself master of Madras, and preserving the most inviolable faith and good conduct towards the English who surrendered, in opposition to the low and dishonorable intrigues of his fellow-countrymen, instigated, supported, and countenanced by M. Dufleix, Governor of Pondicherry. It is to the singular abilities of this man that the Isle of France is indebted for most, if not all the works of a public nature she now possesses. The quay is perhaps unequalled for the advantages it affords to vessels. They lie there in perfect safety: they load and unload with the greatest facility, and they are supplied with water from a jet d'eau, which conveys it into their water casks without removing them from the boats. There are several docks in the vicinity, where ships can be repaired, but as these are private, we have no occasion to describe them, and satisfy ourselves by this allusion to them, in mentioning the harbour to which they approximate in situation, and that they are frequently found of use to vessels that have suffered at sea."

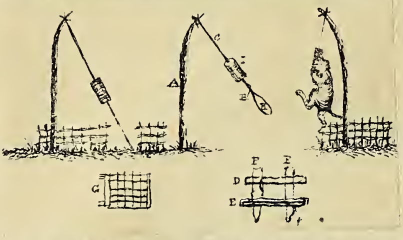
(*To be continued.*)

Art. VII.—Journal of a Tour through the island of Rambree, with a Geological Sketch of the Country, and Brief Account of the Customs, &c., of its Inhabitants. By Lieut. Wm. Foley. *With a map.—Journal of the Asiatic Society,* 1835.

(*Continued from page* 210.)

Lieut. Foley says that the Mughs have no idea of the distance intervening between one place and another: he believes the distance between Oogah and Singhunnethe to be as much as 16 miles; from that to Seppo-towng 12 miles; and as many more from thence to Rambree. Our traveller now proceeds to the capital of the island. The Saaynekyong creek, after winding through the vale to the right, suddenly takes a tour into the interior, crossing the road within a very short distance of Seppo-towng. Patches of paddy ground, succeeded by long mountainous ranges with the same abrupt ascent and inclination, were the never-failing features of the country passed over between Singhunnethe and Rambree.

"The soil on the hills was generally a red clay, containing nodules of chert, and felspar combined with talc. Had I possessed even a common acquaintance with botany, I might have derived much pleasure in the examination of the various vegetable tribes that surrounded me. Unfortunately I was a stranger to the greater number, recognizing only those of most frequent occurrence, such as the *Girjun*, *Tilsah*, *Jharral*, wild *Peepul*, and a host of *Mimosas*. There were also some very pretty creepers, and a vine which corresponds in description with that given me of the black pepper-plant*. After the first two or three ranges had been overcome, we approached the village of *Leppang*, the site of an old stockade, and scene of an encounter between the Burmah chief *Némyo-sooyah*†, and the Ramoo Rajah *Keembrang*, in which the latter was shamefully defeated. From hence it is but a short distance to *Tseembeeyah* and *Kéhsree*, the latter prettily situated on the plain, and surrounded with clumps of trees. Among the inhabitants of *Kéhsree* are a class of people engaged in the oil manufacture, and who shall receive further notice hereafter. The oil is prepared chiefly from the *Thel*, and the mills are in every respect similar to those used in Bengal. Beyond *Kéhsree* is *Koyandowng*‡ with the two guardian temples on its summit: and to the right of that, the "*Red Hill*§" of *Rambree*, almost destitute of verdure, and answering in appearance to that predicated by its name. Tiger traps of a novel construction were very numerous in the ghats leading to the town. *Rambree* has on several occasions been much infested with tigers; they have been known to come into the town shortly after dark, and, entering the houses, carry off the inhabitants. Cattle and poultry are even now continually taken away, and it is considered very dangerous to sleep outside upon the *michaun*. To facilitate the description of one of these traps, I have endeavoured to represent by a drawing the several parts of which it is constructed.



A, is a long ∥ pole possessing great strength and elasticity, which is bent and held down by B, a peg connected with C, a good thick cane rope. The peg B. is fixed with great care between the bars D, and E, ; the bar D, having been previously fastened to the two posts F, F, which are driven into the ground. That part of the platform marked G, is brought into contact with the bar E, and the peg B. H, is a noose laid upon the platform, and I, a heavy wooden cylinder so nicely attached to

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* The black pepper-plant is found on the hill in the Sandoway district.

† Afterwards *Meyo-woon* at *Rambree*.

‡ Called "*St. George's Hill*" by the troops quartered at *Rambree* during the war. The temples were built by the Burmah Meyo-woon *Yeh-jutta-gong*.

§ Already noticed in vol. 2nd (1833,) Journal Asiatic Society.

∥ A large branch of a tree sometimes serves as well.

the cane rope that the least jirk causes it to fall. The platform is laid upon the path frequented by the tiger (generally a gap in a fence, or a ravine), and carefully concealed with grass and leaves. The animal treads upon it and it gives way, disturbing the bar E, and peg B, on which the pole springs up to its natural position, bringing the wooden cylinder with such violence upon the arm of the tiger (already caught in the noose), that it is generally broken by the concussion. This cylinder covers that part of the leg that has been entangled in the noose, and is of great use in preventing the animal from gnawing the rope. The beast hangs suspended in the air at the mercy of the villagers, who dispatch him by means clubs or bamboos hardened in the fire, and pointed at the end so as to resemble pikes.

Arrived at the highest point of the ascent over *Koyandowng*, the large and pretty town of *Rambree*, surrounded with hills and divided by a creek that is seen in the distance meandering towards the sea, appears spread out to view in the vale below."

"The town of Rambree*, with its meandering creek, fine wooden bridges, and the handsome temples that surround it, is perhaps the prettiest spot upon the island; and from no place is it seen to such advantage as from the hills of *Koyandowng*. The creek is not very broad, but it contains sufficient water to admit of the approach of large boats to the market place—a matter of some importance in a country where land carriage is not to be obtained; or, if procurable, would scarcely be available, from the absence of good roads, bridges, and ferries, throughout the island. The town is divded into the following compartments; viz. *Oung-tshiet*, *Shuwe-dong*, *Wedt-chu*, *Tath-tweng*, and *Taing-kuman*. The former commemorates the landing of the first Burmah chieftain at the ghaut of *Rambree*, when the island was first annexed to the dominions of Ava. In *Shuwe-dong*, a large pole, covered at the top with gold, was erected; and in its immediate vicinity, stood a house in which the conjurors* used to dance, invoking the aid of their favourite idol on the occasion of any calamity. *Wedt-chu* was so called from the great assemblage of pigs in that quarter. *Tath-tweng* was the site of the Burmah stockade, and now the locality of the Government jail, formed chiefly from the materials of that stockade. *Taing-kuman* is the place occupied by the *Kuman-thsi*, a class that shall be more particularly noticed hereafter. It is generally admitted that the town has increased in size (though perhaps not in wealth) since it fell into the hands of the British; but this augmentation has been slow, and by no means equal to the expectations that might have been indulged on the change of rule. It would be foreign to the purpose of this brief sketch of *Rambree* to enter into a detail of those causes that seem to obstruct the accumulation of capital; but this much may be said, that the multiplication of taxes, by the intricate division of trades, and the vexatious nature of many of these taxes, is one grand check to the industry of the population; and from thence it is easy to deduce its consequences, as they may affect the revenue, or the morals of the people.

The whole of those improvements which have been made in the town of late years, and contribute so much to the comfort and convenience of the inhabitants, it owes to the taste and liberality of the magistrate† (now residing there), who has devoted large sums of money from his private purse towards the erection of bridges, market stalls, and other public buildings.

Noticing each class under a separate head, with the distinction of sexes, the number of souls residing in *Rambree town* will be as much as follows:

	Adult males.	Adult females.	Boys.	Girls.	Total of each.
Mughs,	1549	1637	1393	1224	5803
Burmahs,	554	473	359	375	1761
Kuman-thsi,	407	383	324	323	1437
			Grand total of souls,		9,001

In addition to the above there are a few Musalmans and Hindus; but their number is comparatively small, and their residence in the town (especially of the latter), attended with so much uncertainty, that I have not thought it necessary to include them in the *census*. The Musalmans were either (originally) adventurers from Cathai and Ava, or owe their extraction to the Musalmans of Bengal, who fell into the hands of the

* Also called "*Taing*," or "*Yaing-Ruah*" by the Mughs; the provinces *Rambree*, *Maong*, and *Thandowey* having suffered considerably from the incursions of the Burmahs and Thaliens during the year 791 M. S. the *Raja* Chou-moeng, on his restoration to the throne of *Rukkhein-preh* (Arracan), adopted such means as were likely to restore them to their former flourishing condition; and, for that purpose, deputed his minister Anunda-Suyah to proceed to those provinces, taking with him such Burmah or Thalien agriculturists and artisans as had been able to quit the country. Anunda-Suyah, in the first place, visited *Rambree* Island, forming colonies, and giving names to the several new settlements, according to the various ominous appearances that presented themselves. It is said, that, during the night his vessel lay at anchor in the *Rambree Creek*, a voice was heard to exclaim,

"*Thain-lo!*" "*Thain-lo!*" Stop! Stop! a favourable omen, inducing a further stay at the place, and the foundation of a town that received the name of "*Taing*" or "*Taing-Ruah.*"

* A set of vagabonds, receiving little countenance from the people at large. A man, attired in woman's apparel, connects himself with another of the profession, whom he calls his husband, and obtains for this husband a woman as his second wife: every respectable native looks upon all this with disgust and horror.

† Captain Williams, 45th Regt. B. N. I.

Rukkhein marauders in earlier times, and were taken prisoners during the wars of the *Rukkhein-preh** Rájás with the Nawábs of Chittagong and Dacca. They are now so assimilated to the rest of the population in dress, language, and feature, that it is difficult to conceive a distinction ever existed. As if ashamed of their Mahammedan descent, individuals of this class have generally two names, one that they derive from birth, and the other such as is common to the natives of Arracan, and by which they are desirous of being known. The Hindus, again, are generally natives of Chittagong and Dacca, who came down into Arracan to pick up what they can, returning to their homes so soon as a certain sum of money shall have been collected.

Under the head of Mughs (*Magas)* are included many inferior castes, such as the *Hyáh*, *Phrá-gyoung*, and *Dhúng*. Much uncertainty prevails with respect to the origin of these castes ; it is either involved in obscurity, or totally lost to those with whom I have conversed upon the subject. By some, it is affirmed, that the *Hyáhs* were originally natives of a country beyond *Manipur*, but nothing further could be obtained, so as to facilitate a discovery of their descent, or account for their settlement in the province. In former days the *Hyáhs* tilled the crown lands, were exempted from taxation, and gave one-half of the produce to the sovereign. It is insinuated by the *Rakkheins*, that not a few of the *Hyáh* caste were employed as eunuchs in the service of the Arracan Rájas. They now occupy themselves in the cultivation of *pawn* and *chilly* gardens, but are looked upon as an inferior caste, and consequently never intermarry with the *Rakkheins*."

Many houses are seen at Rambree; but although it is the second city in Arracan, empty shops on each side the street and other signs of poverty are visible. Here and there a Manchester shawl, a piece of chintz, or printed handkerchief might be seen hung up to view. Few engage in trade ; the greater part of the population are either idlers, day-labourers, agriculturists, or fishermen. At one time Rambree was the grand emporium of trade.

We must here conclude our review of these interesting papers by Lieut. Foley. We admire the style in which they are written ; and, although we are disappointed in our expectations as to his details of the geology of Rambree, he has displayed much talent ; and we trust he will furnish the public with further accounts of this interesting country and its inhabitants.

* Arracan, known in past times as *Rekhapura ;* and so called from its having been the abode of the "*Rakkhus* ;" a fabulous monster, said to devour the inhabitants. The scene of this monster's alleged depredations seems to have been in the neighbourhood of what is now termed the "Fort of Arracan !" (*Vrou-u-mu*, built by Raja Choumoeng, in the year of Gautama 1150, and in the common era 792, or A. D. 1430.) On the extirpation of this monster, Arracan was termed "*Rukkhein-preh*," or "*Rukkhein-táing*," the country of the *Rukkheins ;* an appellation equally common to the natives of Arracan with that of *Mugh*, or *Mogh:* the Burmahs, substituting the letter *Y*, for *R*, call them "*Yukkhein*."

ORIGINAL COMMUNICATIONS.

DESCRIPTION OF SUNDRY NEW SPECIES OF CINNYRIS INHABITING NEPAL.

By B. H. Hodgson, Esq.,
Resident in Nepal.

For the India Review.

TENUIROSTRES CINNYRIDŒ GENUS CINNYRIS.

Section with short even tail.

1st species.—Magna. Great Sun bird, nobis. Above, lively yellow green ; below, flavescent white ; the whole picked out with a large central streak of black on each feather ; alar and caudal plumes, unstreaked ; the former, dusky within ; the latter, throughout concolorous with the body and furnished near the tips with a broad black cross bar : bill dusky ; legs, feet, and claws, bright orange. Sexes alike. Size large, 8 by $11\frac{1}{4}$ inches and $1\frac{3}{4}$ oz : bill $1\frac{3}{4}$ inches, signally large and very moderately curved ; wings to middle of tail ; 5th quill usually longest ; 1st not bastard ; 2nd and 3rd distinctly gradated.* Seems to be nearly allied to the Longirostris of Temminck.

2nd species.—Purpurata auctorum ? Epauletta nobis. Throughout saturate blue, with an intense changeable gloss ; mostly metallic green above, and purple below. Across the breast a sanguine chesnut band ; near the shoulders, under the wings, a brilliant yellow tuft, more or less touched with igneous (unde nomen) ; wings and tail less glossed than body, and black internally ; bill and feet jet black , iris, saturate brown. Sexes alike : $4\frac{1}{2}$ inches by $6\frac{3}{4}$, and $\frac{1}{3}$ oz. Bill $\frac{1}{3}$ longer than head and moderately curved, but more so than in the last : wings to mid-tail, 1st bastard, 2nd long, three next subequal and longest. Indications of subgeneric division ?

3rd species.—Strigula. Stripe-throat nobis. Above, dark olive green ; below, bright yellow ; shoulders and a long central stripe from chin to breast, brilliant deep blue ; alar and caudal plumes dusky or black ;

* According to my experience, this is the more general form of the wing in Cinnyris ; a genus, however, which courts subgeneric division, relatively to the diverse minor diversities of wing, bill, and tail.

the latter tipped and margined laterally in the extremes, with white; a paler line over the eyes, and darker one through them; bill dusky; legs black. The female is earthy brown above, and greenish yellow below. She is without gular stripe or shoulder spot. Size of the last and characters the same.

Section with long wedged tails.

4th species.—Miles nobis. Military Sun bird, nob. Top of the head, upper tail coverts, and tail, metallic green, changing to violet; rest of head, whole neck, breast, back, and shoulders, intense crimson-scarlet; rump, bright yellow; body below, and inferior wing and tail coverts, sordid greenish; remiges and rectrices, internally dusky; the former, rufously edged; long coverts, the same; a long hiacynthine stripe from the base of the lower mandible down either side the neck; bill conspicuously arched: tail as long as the body, gradated throughout; the two central feathers, narrow, pointed, and exceeding the rest by nearly an inch; wings gradated as in the 1st species; 4th or 5th quill longest, six inches long, whereof the tail is three width 6½, and weight ¼ oz.

The female and young wear a sombre russet robe instead of the flaming scarlet of the male: their cap is not burnished, nor have they the splendid mustache; and the central rectrices are neither pointed nor prolonged beyond the series of the rest.

5th species.—Nipalensis nobis. Intire head with the whole neck near it, the upper tail coverts and caudal plumes, black merged externally in an intense metallic green gloss changing to blue; superior and inferior glossed surfaces of the head and neck, divided by an unglossed band passing through eye and ear from the bill; bottom of the dorsal neck and top of the back, sanguineous lake colour; central and largest portion of the back, with the wings, and their coverts, rufo-flavescent olive green; lower back, rump, and the body below, with imal neck and breast, bright yellow, tinted igneous on the breast; lateral tail feathers frequently albescent at their tips; remiges, internally dusky; legs fleshy brown; bill black. Size and characters of the last. The female somewhat less. Above, olive green with a luteous rufous smear; below, paler and yellower: her tail shorter and less pointed. The young males, earthy brown on all the glossed parts of the mature males. So also in miles, and (as I suspect) in all the gorgeous species.

6th species.—Saturata nobis. Black with pale green belly, vent, and under tail coverts; the black ground colour overlaid on the cap, mustache, upper tail coverts, and central caudal plumes, by a splendid metallic blue gloss, changing to violet and hyacinth; and on the whole top of the back and bottom of the dorsal neck by an unglossed sanguine lake dye (the imperial purple of old Rome); across the lower back, a narrow greenish yellow band; lining of the wings and quills basally on the lower surface, albescents; bill, glossy black; legs, dusky. Size and characters of the last; but the tail yet more elongated, longer than the body, and its two central plumes exceeding the rest by as much again as their length. 6 inches long where of the tail is 3¾; width 7 inches; weight ¼ oz.

7th species.—Ignicauda. Fire tail, nobis. Above, olive green; beneath, together with the rump, yellow: chin, cheeks, and front of the neck, blue grey with a greenish wash; breast dashed with fiery red; caudal plumes and their upper coverts intense igneous red; remiges and rectrices, internally, dusky brown; lining of the wings pale green yellow; bill black; legs dusky brown; seven inches long whereof the tail is 3¾, its two central plumes passing the rest by 1¾ inch. Weight ½ oz, or considerably larger than most of the others. The female is smaller, and has her caudal plumes concolorous with the body above and merely *fringed* with fiery red; but the coverts are igneous, and the breast is touched with fire, as in the male. The tail wants the prolonged plumes of the male, as in all the preceding long-tailed species. Ignicauda is distinguished specifically for the comparative straightness of its bill, which is, indeed, distinctly curved, but less so than in any of the above species, save the first, wherein, however, the distinctive feature of the bill is elongation, not straightness. In magna, the rostrum is more than double the length of the head: in ignicauda it scarcely reaches the average excess of the genus, or one-third more than the head.

N. B. In all the above species the iris is brown, more or less dark.

Remarks.—These elegant little birds are very common in all parts of Nepal; nor are they any where migratory. Hereafter I hope to throw some light on their habits and manners, and meanwhile shall only observe that I entirely doubt their alleged nectarinarian diet: I conceive too that the characters of the genus as, given in the Genezoology (Shaw XIV. 229), want revision; 'pollux *gracilis*,' in particular, being the very opposite of correctness.

The Cinnyris Gouldiœ of the Century of Himalayan Birds is, I suspect, meant for our Nipalensis; but, if so, the description is very inaccurate, necnon the drawings. In saturata, indeed, the mantle is almost hollyw sanguine; but in Nipalensis it is

principally flavescent olive, the dark sanguine hue (imperial purple of the ancients) being restricted to a band between the shoulders and bottom of the dorsal neck. So far from being "exceedingly rare," this species is much the most common of all, and I have now twenty specimens lying before me, notwithstanding my large despatches to England.

DESCRIPTION OF A DIPTEROUS FLY, THE LARVA OF WHICH PRODUCES A KIND OF GALL ON THE LEAVES OF THE FICUS RACEMOSA.

By P. F. H. Baddeley, Esq.

For the India Review.

A species of gall gnat (order, diptera; tribe, cecydomyia) also deposits its eggs in the parenchymous substance of the leaf of the ficus racemosa, which turns into a small light coloured grub; this latter, feeding upon the juices of the plant, changes into a chrysalis; and this again, after a few days, into a little two winged insect. The larva, by its irritation, causes that part of the leaf in which it resides to swell into a flat kind of blister, in the centre of which a single insect is confined.

The chrysalis is of a reddish brown colour approaching to black at the anterior part, where it is provided with four tuberches, having much the appearance of a pig's snout: by means of these, it forces itself partly out from the under surface of the leaf, when, the skin bursting, the fly escapes.

The colour of the perfect insect is of a light brown with the antennæ darker, and the head, which is entirely occupied by two compound eyes, black. Its body and wings are covered with long hairs.

Metamorphosis.—Incomplete or coarctate.

Wings.—Two, with large poisers.

Antennæ.—Verticillate, composed of 24 joints alternately large and small.

EXPLANATION OF FIGURES.

Figs. 1 and 2.—Under and upper surfaces of a leaf of the ficus racemosa containing several of these false galls.

Fig. 3—A section of one.

Fig. 4 and 5.—Larva.

Fig. 4 *a.*—Do. in the nucleus of the gall.

Fig. 6.—Pupa.

Fig. 7.—Perfect insect.

Fig. 7. *a.*—Part of an antenna

Fig. 7. *b.*—A wing.

Fig. 7. *c.*—A wing magnified.

GENERAL SCIENCE.

NOTICE OF SOME RECENT IMPROVEMENTS IN SCIENCE.

HEAT AND LIGHT.

1. TEMPERATURE OF THE GLOBE.—M. Poisson, in his elaborate work entitled *Mathematical Theory of Heat*, has broached some new notions in respect to the source of the earth's heat. He observes, that the spherical form of the earth, and its flattening at the poles, prove that it was originally in a fluid, or perhaps in a gaseous state. After this period, it can only have become solid, either wholly or in part, by a loss of heat, proceeding from the circumstance that its temperature exceeded that of the medium in which it was placed. He conceives, that it has not been demonstrated that the solidification commenced at the surface, and gradually extended to the centre, as those theorists assert who adopt the idea of a fluid centre. The contrary appears to Poisson more probable; those portions nearest the surface having been cooled first, have descended into the interior, and been re-placed by matter from the interior, which has again descended in its turn, and thus the process was repeated until the whole mass was cooled down. But further, the central layers would become solid, in consequence of the immense superincumbent pressure at a temperature equal to, or even superior to that of the layers nearer the surface. Experiment has proved that water at common temperatures, when submitted to a pressure of 1000 atmospheres, undergoes a condensation of about $\frac{1}{20}$ of its original volume. Now, if we conceive a column of water equal in height to the earth's radius, and reduce its weight to one half of what it possesses at the surface, in order to render it equal to the mean gravity of each radius of the earth, supposing the latter homogeneous; the inferior layers of this liquid column will undergo a pressure of above three millions of atmospheres, or equal to above three millions of times that which reduced the water $\frac{19}{20}$ of its volume. Without any knowledge of the laws of the compression of this liquid, we must still believe, that such an enormous pressure would reduce the inferior layers of the mass of water to the solid state, even when the temperature was very high.

In order to explain the elevation of temperature which we observe, in proceeding from the surface towards the centre of the earth, he suggests the effect of the inequality

Fig. I.

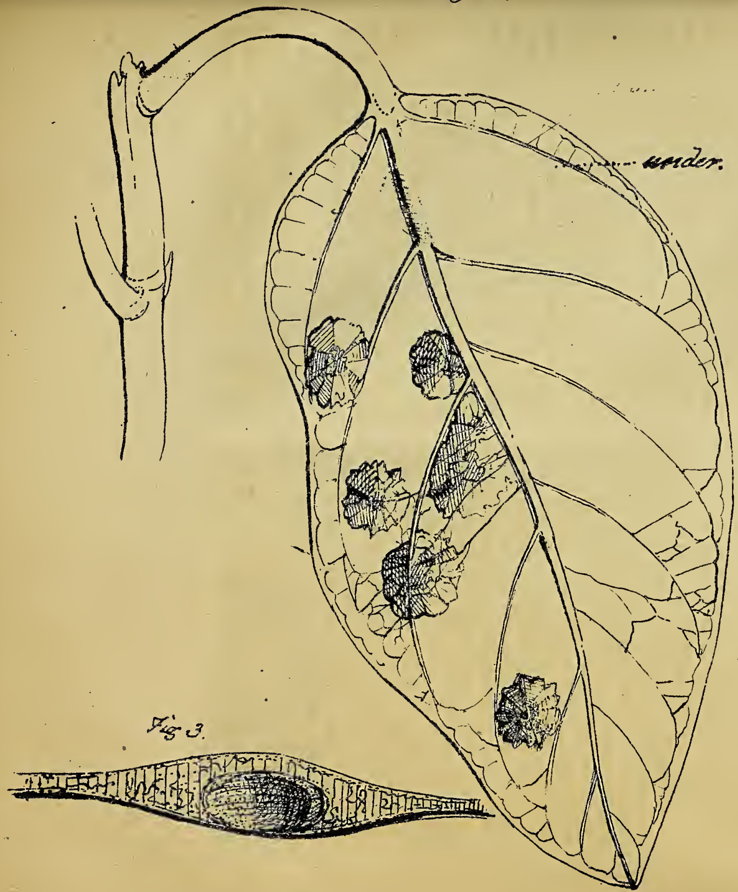


Fig. 3.

Fig. 2.

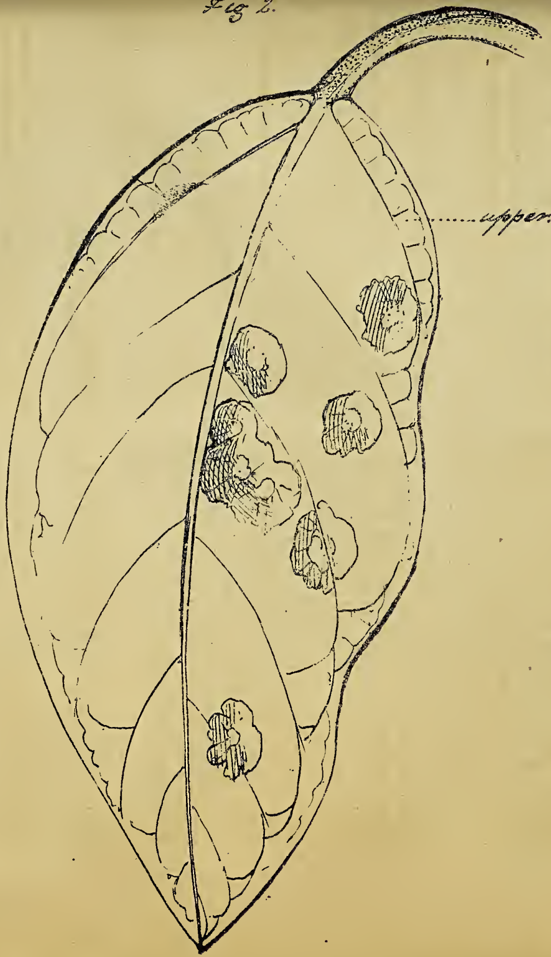


Fig. 4.

Fig. 5.

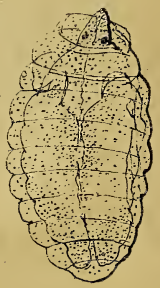
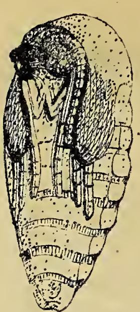


Fig. 6



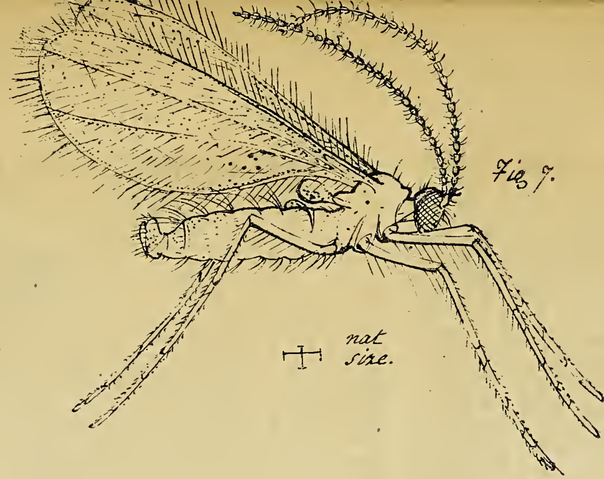
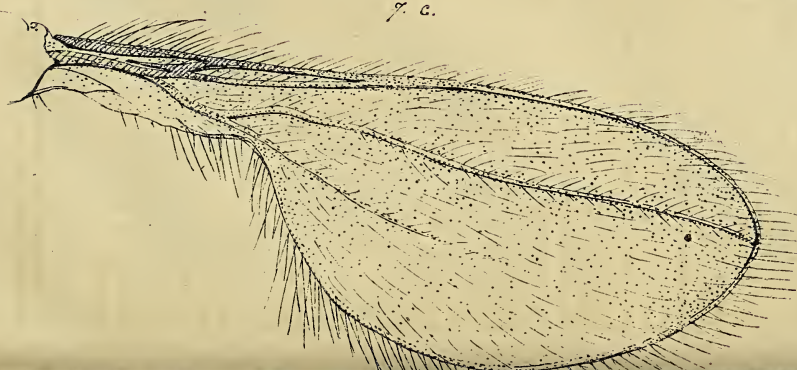


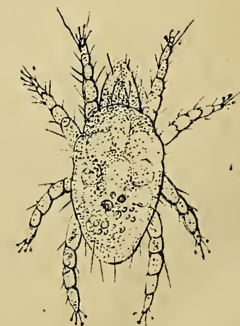
Fig. 7.

7. a

7. b.

7. c.





A mite on the leaf of Ficus Racemosa

of the temperature of the regions of space, which the earth successively traverses, because he considers it very improbable, that the temperature of space is every where the same. The mean temperature of space may be admitted to differ little from zero, in place of being, as has been generally calculated below the temperature of the coldest regions of the globe. The variations in the temperature of space may, however, be very considerable, and they ought to produce corresponding variations in that of the earth, which will extend to depths dependant on their extent and degree. "If we suppose, for example, a block of stone to be carried from the equator to our latitudes, its cooling will have commenced at the surface and extended into the interior, and if it has not reached the whole mass because the period has been insufficient; this body when it has arrived in our climate will present the phenomenon of a temperature increasing from the surface. The earth is in the condition of this block of stone; it is a body which proceeds from a region whose temperature was superior to that of its present situation; or, if we wish, it is a thermometer, moveable in space, which has not time, inconsequence of its great dimensions and its degree of conductibility, to take in through its whole mass the temperature of the different regions which it trasverses. At present, the temperature of the globe increases below its surface. The contrary has already, and will again take place. At other periods, besides at epochs separated by numerous ages, this temperature ought to be, and will be, by consequence, much higher or much lower than it is now, which prevents the earth from being always habitable by the human species, and has, perhaps, contributed to the successive revolutions of which its external layer has preserved the traces."*

2. THEORY OF HEAT AND LIGHT.—Ampere, in stating his views in reference to a theory of heat, sets out with defining *particles*, *molecules*, and *atoms* which he considers to enter into the constitution of matter. A *particle* is an infinitely small portion of a body, and of the same nature with it, so that a particle of a solid body is solid, that of a liquid body liquid, and that of a gas aeriform. The *particles* are composed of molecules kept at a distance: 1. By what remains at this distance, of the attractive and repulsive forces peculiar to the atoms; 2. By the repulsion which the vibratory motion of the interposed ether establishes between them: and 3. By the attraction directly proportional to the masses, and inversely as the square of the distance. *Molecules* consist of a collection of atoms kept at a distance by attractive and repulsive forces peculiar to each atom. *Atoms* are material points from which these attractive and repulsive forces emanate.

* Bibliotheque Universelle, June, 1835. Ann. de Chimie, lix. 71.

From this definition, it follows, he considers that a molecule is essentially solid, whether the body to which it belongs be solid, liquid, or gaseous; that the molecules are polyhedrons, of which these atoms, or at least a certain number of these atoms occupy the summits, and it is these polyhedrons that are termed primitive forms by crystallographers. The particles alone can be separated by mechanical means. The force which results from the vibrations of the atoms may separate the compound into simpler molecules. Chemical action can alone separate the latter. Thus, in detonnating a mixture of 1 volume of oxygen and 2 volumes of hydrogen, by which 2 vols. of vapour of water are formed, each molecule of oxygen is divided into two, and the atoms of each of these halves unite with the atoms of a molecule of hydrogen to form a molecule of water. Proceeding upon these premises, Ampere distinguishes the vibrations of molecules from those of atoms. In the first, the molecules vibrate together, approaching and retreating alternately the one from the other, and whether they vibrate in this manner or remain at rest, the atoms of each molecule vibrate and, in fact, always do vibrate by approaching and retreating the one from the other alternately, without ceasing to belong to the same molecule. The latter, he terms atomic vibrations. To the vibration of the molecules, and to their propagation in the surrounding media he attributes all the phenomena of sound; to the vibrations of the atoms he ascribes all those of heat and light.*

3. OPTICAL PROPERTIES OF CHARCOAL.—If a portion of well burned fir charcoal be placed upon a layer of heated coal on a wind furnace, and all openings be closed, so that no air can penetrate below the coal, the combustion will be carried entirely by the decomposition of the carbonic acid. After the fire has subsided, Degen found that the portion of lcoal had wholly or in part dissolved into a mass of fibres, which did not adhere strongly to each other. When examined under the microscope they were found to be round tubes; they are more or less translucent, and their colour by transmitted light is brownish yellow. These tubes have round apertures on their sides, whose margins are thicker than the rest of the sides; some of them when of a large size, however, have no edges of any considerable diameter. When heated to whiteness in platinum foil before the blowpipe, these tubes lost their translucency and became very brittle. The diameter of these tubes was from about·00049 inch to 0000908 inch. There is remarkable appearance observed when the miscroscope is directed through one of the apertures upon a distant (*entfernten*) object. This object appears double. One of the figures stands *upright* about. 0004 behind the opening; it is, at least so distinct, that

* Ann. de Chim. et de Phys. lviii.

we can see the window-post clearly. The second figure is inverted, and appears before the opening; it is more indistinct than the first. These appearances belong to the phenomena of diffraction. The form which the charcoal assumed, by the powerful heat applied in the manner described, is similar to the filamentous nmatter examined by Dr. H. Colquhoun, which was obtained during some trials made by Mr. Macintosh to convert iron into steel, by surrounding it with coal gas in an air tight iron chest.*

RECENT RESEARCHES IN GEOLOGY.

Geology is a subject of immense extent; and the discoveries which are made in it almost necessarily proceed by slow steps and minute details. Hence it would be utterly impossible, even in a memoir of considerable length, to give a complete and comprehensive survey of the recent progress of this rapidly advancing Science. But here, as in all sound inductive researches, the accumulation of particular facts generally terminates, after a while, in the development of some great general principles. When such epochs occur, it it often very practicable to condense into a short compass, and in a generally intelligible form, a statement of the results so obtained. This is what we shall attempt, in the following article, with respect to one or two leading subjects of geological inquiry, which have not only excited peculiar interest of late, but also have important bearings on the principles of Science, and on some of the most instructive inferences and contemplations into which we are led by the study of it.

The conclusions of geology, like those of every other part of inductive science, must be grounded on the *sole* authority of well-ascertained and classified facts; and we must be guided to them, neither by random conjectures, nor the dictation of authoritative opinion, but by the *sole* pursuit of well-founded natural analogies. We must seek to interpret the past from the present, and advance from the known to the unknown.

Proceeding on such principles, then, we shall presume that our readers will acknowledge the force of the reasoning by which it is inferred that where two beds, or strata, lie one over the other, the former was deposited or formed *subsequently* to the latter; that each one of the vast number of lesser beds or layers, of which even a small thickness of any stratum is composed, were all formed one after another; and, when we come to distinguish the larger divisions and classes of strata, by the fossil remains of plants and animals, which we find imbedded, and often completely mineralized in them,—that these are the remains of creatures which actually lived and died during the period at which the depositions took place respectively; and that the lowest rational estimate we can form will not allow us to suppose any short or limited period of time as requisite for the formation of any one bed, the enclosing in it of all its organic remains, and (marine or aquatic as those remains so universally are) its elevation from the bottom of the primæval ocean into dry land.

Pursuing our researches on these simple and truly philosophic principles, we are brought in succession to recognise an immense series of deposits, characterized by organic remains, in which the skill of the naturalist and the anatomist detects species, genera, entire orders of living beings which do not now exist. The deposits in which these occur, now in a great degree hardened and consolidated into rocks, are thus characterized as distinct formations which have gradually emerged at successive remote epochs, at incalculably long intervals of time. Other classes of phenomena are observable in a series of rocks of a different texture, and wholly destitute of organic remains, which appear protruded, as it were, among and through the others: having, in many cases, an exact resemblance to the effects of existing volcanoes,—and in all, following a close analogy to such modes of eruptive action.

We shall in the following sketch presume no further on our reader's acquaintance with the subject than to the extent here briefly described. The names given to the successive leading groups of formations, which all over the world succeed one another in this order, are principally, the tertiary (or newest), above the chalk. The secondary, from the chalk inclusive to the coal formations: then those which have been called transition; and, lastly, the primary, of crystalline texture, without organic remains, and bearing marks of being upheaved, protruded, or forced through all the others, in the way that masses of melted matter are now forced up by volcanic action.

SILURIAN AND CAMBRIAN FORMATIONS.

Mr. Murchison and Professor Sedgwick have been for a long time directing their joint labours to the elucidation of the rocks usually confounded together under the unmeaning name of "Transition," comprising all the series intervening between the old red sandstone and the primitive rocks. They have been minutely examined by these two eminent geologists, as developed in Wales and the part of England adjoining, and they have succeeded in dispelling almost entirely the obscurity in which the nature of these rocks has been long involved.

From beneath the old red sandstone, there rises out this considerable group of rocks, which, taking them in the order from upper to lower, Mr. Murchison has named the Ludlo, Wenlock, Caradoc, and Llandeillo formations, each being distinguished by characteristic organic remains, and frequently by subordinate beds of limestone. These beds form a well-marked connected group, inter-

* Poggendorff's Ann. xxxv. 468.—Thomson's Inorganic Chemistry, i. 160.

posed between the old red sandstone and the slaty-grauwacke of Wales. Hence it seemed very desirable to apply some distinctive name. So great have been the recent advances in geology, that the term "transition," formerly applied, has (as we observed above) now become wholly unmeaning, and, in fact, conveys incorrect impressions. Hence these geologists have adopted the name "Silurian System," (from the Roman name for this part of Wales;) and this they subdivide into the "Upper Silurian," comprising the two first of the four classes named above,—and the "Lower," including the two last.

Beneath these appear the various slaty rocks, which are common to Wales and Cumberland. These Professor Sedgwick has minutely investigated; and divides them, according to order of superposition, into upper, middle, and lower. The upper formation is seen in the chain of the Berwyn mountains, and is thence expanded over a large part of South Wales, including Plinlimmon; it contains in general less calcareous matter, and fewer organic remains, than the Silurian systems. The middle Cambrian includes the Merionethshire ranges and Snowdon, containing a few organic remains, and some highly calcareous slates, but no beds of limestone. The same group is largely developed in Cumberland. The lower or oldest Cambrian group occupies the south-west of Caernarvonshire, and much of Anglesea. It contains no organic remains.

In this rapid sketch, we, of course, can do little more than explain the nominal distinctions which have been thus laid down. But it must be understood, that they are far from being mere distinctions of names. They involve essential characteristics of extensive geological districts, and serve to bring under a luminous classification a series, of great importance to a connected knowledge of British strata, which has long been involved in obscurity from want of such a principle of arrangement.

A full account of these researches was given at the Dublin meeting of the British Association; and elicited besides the encomiums so justly due to the talents and perseverance of its authors, many able illustrations and remarks; especially from Mr. Greenough, who considered that similar principles of classification might very probably be extended to other regions; and from Professor Phillips, who made some highly interesting observations on the distribution of characteristic organic remains in rocks, especially those here considered. He dwelt upon the important fact, so utterly destructive of the favourite hypothesis of some geologists and cosmogonists, of a gradual advance from the simplest to the most complex forms of animal life, as we advance to the newer rocks; that in these Silurian groups, though we find a diminution in the number of fossil species in the older rocks, yet they exhibit *no inferiority of structure or organization*. They belong to extinct classes. Among beings of lower organization, as among shell-fish, some single species may be found even in rocks so ancient as the Silurian system, which also now exist; and he was hence led to remark, that it is not by any single genus, but by a combination of co-existing genera that strata must be identified.

FOSSIL FISHES.

The natural history of fishes has been generally considered more obscure than that of any other of the great divisions of the animal kingdom; and it has been almost entirely through the labours of M. Agassiz that a new light has been thrown over it, by tracing out, as he has done, a new principle of classification: by this the whole science has been remodelled. It is also a singular circumstance in this investigation, that (contrary to the usual order of procedure) the study of the fossil remains of fishes has been a material source of elucidation for understanding the relations and classification of existing species.

The great principle of classification adopted by M. Agassiz, is derived from the nature of the *external covering or scales*. The peculiar form and structure of the scales differ essentially in different classes of fishes; and the nature of the covering, which protects the animal externally, is found to bear a direct relation to the internal organization. Here then there appears a principle of relation which, doubtless, depends upon some essential modification of the animal character, and thus may fairly afford a satisfactory ground of a real distinction and classification of species. This principle, then, M. Agassiz has adopted; and, in following it out, has arrived at a grand distinction of fishes, under four principal orders, characterized by the peculiar nature of their scales. They are termed, 1. Placoïdians, 2. Ganoïdians, 3. Ctenoïdians, and 4. Cycloïdians *.

Of the whole number of species now known to exist, more than three-fourths belong to the two orders of Cycloïdians and Ctenoïdians, the other fourth to the remaining two. Whereas, of the species whose fossil remains we find imbedded and mineralized, none of the two orders last-named have been found in any formations below the chalk; whilst in the lower or older formations we have abundance of the other two kinds. The proportions of these in the different formations are very remarkable, and have been carefully traced by the persevering industry and skill of M. Agassiz.

In the most recent or tertiary deposits, not only the fossil orders and genera, but also the species, *approach* nearly in character to

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*** These names are derived from Greek words, describing the shape and appearance of the scales.**

1. From *plax*, a table or broad surface, the scales being large.

2. From *ganos*, beauty or splendour; from the bright enamel with which they are armed.

3. From *cteis*, a comb, the scales being formed with teeth.

4. From *cyclos*, a circle, the scales being round.

those now existing: though he has not found more than one *species exactly* the same. Those of the formation called "crag," in Norfolk, are allied to the species now inhabiting the tropical seas. In the London clay, the beds in the basin of Paris, and at Monte Bolca, about two-thirds belong to existing genera.

In the formations next below these, the chalk, about one third only belong to existing *genera*.

In the formations older than the chalk, there is not a single *genus* identical with the recent. The oolitic series, to the lias inclusive, forms by its species of fossil fish a very natural and well-defined group. The weald formation is included in this, in which M. Agassiz did not find a single species referrible even to the genera of the chalk.

Throughout the series of rocks deposited in these epochs, the two *orders* which prevail by so large a majority (as above stated) in the existing creation, are not to be found. New species have since been created; the whole genera formed of all those species are new, not merely in a few instances, but through such a range and extent, that even the entire *order* comprising those *genera* is new. In these older strata, on the other hand, different species, genera, and orders, existed in proportional abundance, most of which have since died away and disappeared; and the two great orders, which at the present day form a small minority, were then predominant.

The most striking characteristics, perhaps, of these periods are the predominance of those Ganoïdians which have a symmetrical caudal-fin; and those Placoïdians, which have their teeth furrowed on both sides, and have large thorny rays on the dorsal-fin. These fossil rays had long been known, but their real nature was wholly misunderstood.

In the formations below the lias, the character, above stated, in the tail-fin of the Ganoïdians is entirely changed. Instead of a tail parting off into two equal and similar divisions or lobes, the backbone is continued straight on, into a true tail, while another lobe, or fin, is formed beneath, so as to give the appearance of a tail-fin, with two unequal, unsymmetrical, lobes. This distinction prevails up to the fishes of the most ancient strata.

The form of the teeth is another important distinction, bearing obviously a direct relation to the habits of the animal and its means of subsistence.

In strata more recent than those containing coal, we find no fish decidedly carnivorous,—that is, provided with large conical and pointed teeth. In these strata, up to the chalk, the fish appear to have been omnivorous, their teeth being either rounded, or in obtuse cones, or like a brush. The nature of the food of these fish is also ascertained by the discovery of the fossil contents of their intestines, in which scales of other fish, on which they had preyed, have been found.

In a great number of instances from the tertiary beds of the Isle of Sheppy, the chalk, and the oolite rocks, it is a highly interesting fact, that the capsule of *the eye* has been preserved: and in many species from Monte Bolca, Solenhofen, and the lias, we see distinctly all the little blades which form the branchiæ.

In the strata below the lias, we begin to find the largest of those large fish, of an organization allied to the Saurian, or lizard tribe; the resemblance is chiefly in the mode of connexion of certain parts of the skeleton, and the form of the teeth.

From the general distribution of the species of fossil fish thus investigated, M. Agassiz has deduced some important and profound inferences, with regard to the changes which our planet has undergone at remote epochs.

There is a remarkable distinction between these fossil fishes, and the fossil *zoophytes and testacea*. Of these last, the same genera are found through several different formations, as we have already noticed; and their organization was such as enabled them to live through all the great changes in the physical condition of the globe, which accompanied the successive depositions of those formations. With the fossil *fishes* the case is widely different. We have seen that the several genera, and even orders, vary extremely from one formation to another. Thus the changes in the constitution of the globe, which accompanied the successive epochs, were of such a kind as these genera of fishes were unable to survive. We see at once, then, a reason for this difference between them and the inferior classes, in the greater perfection and delicacy of their organization; their more complicated structure required important modifications, according as great changes took place in the climate, and various physical relations in the order of things on the surface of the globe. Here then was the same beautiful series of adaptations, existing in as high perfection myriads of ages ago as at the present time: displayed equally in all the long series of creations, by which the globe has been gradually brought into its present condition, and evincing the ever-enduring and universal influence of the same creative Power and Intelligence.

The fishes of each of the great periods of the earth's formation are thus essentially different from each other, but each series agreeing among themselves in some peculiarities of organization. The multitude of species so coexisting must, doubtless, have been fitted by that peculiar organization for the particular conditions which prevailed on the surface of the globe at the time they lived. So, likewise, the disappearance of whole species and genera, is the evidence of great and universal changes in those attendant conditions of the external world, which introduced a new order of things unsuited to that peculiar organization with which they were furnished. Thus, not only individuals, but whole families and species perished; not only a few species, but a wide range of species, comprising a whole genus; and not only this, but so many genera as made up the larger portion of an entire order. One common peculiarity constituted the distinction of the order; that peculiarity was no

longer suited to external nature,—the whole order therefore perished.

Did then these vast alterations in the plan of nature take place suddenly? Was this immense destruction, not only of animal life but of a whole system of organization brought about at one time?—in a short time; or did it take place by more gradual changes? by a series of changes so slow as to be imperceptible, going on through a countless series of ages?

M. Agassiz has introduced some remarks bearing on the solution of these questions. He observes that, in some cases, local and transient causes may be capable of producing such effects over a certain extent of district: such, for example, as volcanic eruptions. A submarine eruption might destroy all the fish in the particular region where it took place; but this would hardly account for the disappearance of *species* and *genera*, however extensive or often repeated. M. Agassiz possesses specimens in which a great number of fossil fishes are crowded into a small space; and the appearance of the whole is such, as to impress the spectator with the belief that they were destroyed and imbedded, as it were instantaneously, by some sudden catastrophe: such as a sudden eruption of volcanic matter, or a sudden influx of fresh water, or even the heating of the sea by a submarine volcano.

Such causes as these, however, could be only local; and it is evident we must refer to changes, upon a much larger scale, in the condition of the earth's surface, as alone capable of producing the greater effects we have above described. M. Agassiz appears to lean to the theory of those geologists, who contend that the great changes which have affected the crust of our globe were brought about by vast and sudden catastrophes and that, corresponding with the occurrence of these convulsive movements, the great changes in the characteristics of animal and vegetable life were as suddenly introduced. Those of our readers who have perused the masterly but extremely popular work of Mr. Lyell (and we hope there will be few who have not), will know how to estimate the claims of this theory.

M. Agassiz commenced his researches on the Continent; but has, more recently, extended them to an examination of the specimens found in English collections. Here, indeed, we have been long accumulating these geological treasures, in which our island is peculiarly rich, but without fully understanding the value of them, until M. Agassiz has pointed it out to us; and invested many of these accumulations of neglected remains, with a new value and interest. He has found, in the English cabinets, 300 species *new* to his researches. Here, then, was an interesting, perhaps critical, moment for his speculations: his views were thus put to a severe test. All these specimens, however, were found to furnish a complete verification of his former inferences, and entirely to corroborate the laws of development which he had previously determined, in regard to the succession of these orders of animals, during the different changes which our globe has undergone.

The oldest formation in which fossil fishes are found, is the Silurian system of rocks; in which there are five or six species, exhibiting the first appearance, in the primæval world, of this long-continued series of vertebrated animals; the species of which become more and more diversified and numerous, as well in their outward forms as in their organization, as we advance to the later formations. Yet, as we have indeed already noticed, those which do occur even in these most ancient rocks, the first of living beings which tenanted the globe, were animals of the most perfect and exquisite structure and organization.

A highly interesting account has lately been given to the Geological Society, by Mr. Murchison, of the discovery of fossil fish, in the new red sandstone of Tyrone, in Ireland, being the first discovery of such remains in the particular stratum, though they were known to exist in others of the group to which it belongs. The part of the formation in question surrounds, and includes, a small coal-field, but reposes, for the greater part, on mountain limestone. The sandstone consists of many distinct beds, which have evidently been deposited at different, and widely separated, periods of time; since some of the lower exhibit, on the upper surface, the marks of the rippling action of water, and must, therefore, have long presented an exposed surface to a calm sea. It is in the lowest beds, twenty-five or thirty feet below the surface, that the fishes are found.

Another curious and interesting fact, connected with these researches, has been the light thrown by them upon some very singular specimens, which had been, for years, in the possession of Dr. Buckland, but of which neither he, nor any of the numerous geologists and naturalists who examined them, could make out anything. They are now ascertained, by comparison, to be the jaw-bones of a rare fossil fish, of which four different species are now recognised, in the oolitic formation, by the acute investigations of Dr. Buckland.

We have alluded to some remains of fossil fishes, which bear a resemblance to those of the Saurian reptiles, (the tribe including the lizards and crocodiles). We must not omit one very remarkable instance, which throws considerable light on this sort of relation.

In the limestone of Burdie-house, in Scotland (belonging to a deep-seated bed of the coal formation, beneath all the beds of coal), numerous specimens of fossil fish were discovered by Dr. Hibbert, a few years ago. Amongst other remains, he has since found, in this locality, many specimens of teeth, scales, and large bones, apparently of a Saurian character. This being mentioned to M. Agassiz, he at once traced an analogy which has enabled him to explain, with the highest probability, the nature of the animal to which they belonged. In the tropical parts of

America, he immediately called to mind a species of fish (the Lepidosteus), now existing, which has, in many points, a striking resemblance to the lizard tribe. The form of its scales particularly, as well as of its teeth, are extremely similar to those of the crocodile genus; and even its internal organization forms a sort of connecting link between that of a fish and a lizard. The swimming-bladder, when minutely examined, is found to be, anatomically, a true *lung*; and approaches closely in structure to the lungs of reptiles. It has a regular trachea, communicating with a glottis, surrounded by ligaments intended to open and shut it, constituting an apparatus even of a more complicated structure than that of many reptiles. The heart, again, resembles that of a reptile in some particulars.

With this fish M. Agassiz compared the sauroid remains (as they had been provisionally termed,) found at Burdie-house: he was materially assisted, also, in making out the analogy, by the entire head of a large fossil fish in the museum at Leeds. By this sort of comparison, he has at length classified the fossil remains into a new genus, under the name of Megalicthys; of which more than one species are now recognised in the coal-fields of Scotland.

These investigations were given in a paper, read to the Royal Society of Edinburgh, by Dr. Hibbert (Dec. 1834), who, in conclusion, well observed the importance, in geology, of such analogies with living species. In this instance, he observed, "M. Agassiz had rescued from obscurity a sauroid fish, dwelling among the lakes and rivers of the most thermal regions of America, and rendered it elucidative of one of the most earliest states of our planet, when, in the language of this naturalist, fish united, in their particular organization, the character of reptiles, belonging to that class of animals which only appeared in far greater numbers during a later epoch."

ELEVATION AND SUBSIDENCE OF LAND.

A paper was read to the Geological Society, November 18, 1835, in which Dr. Pingel, of Copenhagen, gives a detailed description of the evidences which he has collected in a tour, of the fact of a *subsidence*, during the last half century, of the *west coast* of Greenland, between N. lat. 60° and 69°. This is evinced by the ruins of houses and villages on the shore, which are now covered at high water, and, in some instances, are only visible at very low tides.

From a statement, by Captain Fitzroy, R. N., read at the same meeting, it appears that the earthquake of February, 1835, on the coast of Chili, not only produced an alteration in the currents but that the island of S. Maria was permanently elevated ten feet. Another, and more detailed, account of the same earthquake, was given in a letter from Mr. Alison. The most remarkable circumstances were these: Forty minutes after the first shock, the sea suddenly retired so far, that a great part of the bottom of the bay, at the port of Talcahuno, was laid dry; but the water very soon afterwards returned with increased violence, and flowed twenty feet over the town, carrying everything before it. This was repeated three times. The same thing occurred in the earthquake which destroyed Penco, in 1730 and 1731. In the present instance, the land permanently rose two or three feet on the shore and in the bay. Mr. Alison also mentions the existence, near Valparaiso, of *recent* marine shells, 1400 feet above the level of the sea; and, in the bay of Valparaiso, he says, a rock, which, in 1817, could be passed over in a boat, is now dry except at spring-tides.

At the island of Juan Fernandez, a similar recession, and then violent influx of the sea took place; but here it was accompanied by another remarkable phenomenon, namely, the breaking out of a submarine volcano, which caused an immense agitation and boiling of the sea.

At a meeting, of December 2nd, a paper was read on the effects of earthquake waves on the coasts of the Pacific, by Woodbine Parish, Esq. In this valuable memoir, the author has collected all the information he could obtain from well-authenticated historical accounts of earthquakes, producing those sudden overflowings, or rather immense waves, in the sea of which we have just spoken. These are highly curious, and attest the vast force with which inroads of the ocean, under these circumstances, have taken place. They by no means *always* accompany earthquakes: in fact it evidently depends on the direction which the shock takes, and the locality of its origin, whether such an effect will be produced or not.

A most remarkable and instructive example of the gradual and permanent rise of a large tract of land, is that described by Mr. Lyell as now taking place in Sweden. (*Phil. Trans.*, 1835, i.)

It is more than a hundred years since the Swedish naturalist, Celsius, declared his opinion that the level of the waters, both of the Baltic and the ocean, was suffering a gradual depression; that is, that there was a change in the *relative* level of the land and the sea.

Von Buch, in the course of his tour in Sweden and Norway, about twenty-five years ago, found, at several places on the western shores of Scandinavia, deposits of sand and mud, containing numerous shells referrible to species now living in the neighbouring ocean. From this circumstance, and from accounts which he received from inhabitants of the coasts of the Bothnian Gulf, he inferred that Celsius was correct in regard to a gradual change of relative level. As the sea cannot sink in one place without falling everywhere, Von Buch concluded that certain parts of Sweden and Finland were slowly and insensibly *rising*.

Some difference of opinion, however, prevailed on the subject; and there were not wanting able observers, who contended that the inferences were founded on mistaken data, and, on other grounds, denied the truth of the statement altogether. The question

thus acquired additional interest: and Mr. Lyell, determined to investigate the facts himself, made a tour into Sweden for the purpose.

He visited a considerable part of the shores of the Bothnian Gulf, between Stockholm and Gefle, and of the western coast of Sweden, between Uddevola and Gothenburg, districts particularly alluded to by Celsius. He examined several of the marks cut by the Swedish pilots, under the direction of the Swedish Academy of Sciences, in 1820, and found the level of the Baltic, in calm weather, several inches below the marks. He also found the level of the waters several feet below marks made seventy or a hundred years before. He obtained similar results on the side of the ocean; and found, in both districts, that the testimony of the inhabitants exactly agreed with that of their ancestors, recorded by Celsius. After confirming the accounts given by Von Buch, of the occurrence, on the side of the ocean, of elevated beds of *recent* shells at various heights, from 10 to 200 feet, Mr. Lyell discovered, in addition, deposits on the side of the Bothnian Gulf, between Stockholm and Gefle, containing fossil shells of the same species which now characterize the brackish waters of the sea. These occur at various elevations, of from 1 to 100 feet, and sometimes reach fifty miles inland. The shells are partly marine and partly fluviatile: the marine species are identical with those now living in the ocean, but are dwarfish in size, and never attain the average dimensions of those which live in waters sufficiently salt to enable them to reach their full development. Mr. Lyell concludes, in general, that *certain parts of Sweden are undergoing a gradual rise, to the amount of two or three feet in a century*, while other parts, visited by him, further to the south, appear to experience no movement.

All these facts have an extremely valuable bearing on geological theories. The fact that a slow, and imperceptibly gradual rise, is now taking place in one large district of the earth, whilst a sinking has been also going on in another, afford us the strong ground of observed facts for admitting, as a true philosophical cause, the like slow, gradual, elevation of land out of the sea, in other cases and in earlier epochs. To account for the actual appearances of strata, now hundreds or thousands of feet above the sea, containing beds of marine shells and animal remains, we require nothing but a repetition, or rather constant succession, of such events as are now going on in Sweden and Greenland, to account for all those level, or but slightly inclined depositions, which, to so vast an extent, have contributed to form our existing continents. And where is the slightest ground of probability for supposing these changes to have gone on at a more rapid rate formerly than now? And if we form anything like the roughest calculation, what length of time shall we assign for the elevation of any one, even of the superficial and most recent formations?

But the effects of earthquake waves is a subject not less worthy of consideration. Some geologists have contended that the sudden elevation of mountain chains, by volcanic forces, of whose intensity nothing, in the present degenerate condition of the globe, can convey any idea, caused mighty waves, deluging, at one sweep, vast regions of the earth, and accounting for numerous phenomena, which those of another school attribute to the action of ordinary causes, acting through immensely long periods of time. These earthquake waves give us an idea of the extent to which such causes can act under the influence of volcanic forces, of the highest intensity of any within human experience; *i. e.*, capable of producing local inroads, on particular coasts, to an extent absolutely insensible compared with those which must be imagined in order to account *in this way* for geological phenomena. We may then calculate, in some degree, what enormous intensity must be supposed in an earthquake, to cause an inundation of any considerable tract of country. Further, we must own, we find it impossible to conceive how the upheaving of a mountain, from the bottom of the sea, supposing it merely to ascend uniformly and steadily, could produce *any wave at all*. It seems to us solely the trembling motion and rapid shock of the earthquake, which produces the wave.

ON AN INCREDIBLE EXPERIMENT IN WHICH THE HUMAN BODY LOSES ITS WEIGHT.

RELATED BY SIR DAVID BREWSTER AND ANOTHER.

Highly exciting as the "marvellous" may be to a large proportion of mankind, even in the most advanced state of civilization yet known, it ought never to be drawn from sources whence truth may be obtained by ordinary industry of research, nor furnished by men whose *dicta*, from their intellectual rank, may be received, without examination or suspicion, not only by the ignorant and unreflecting, but by many who are in the habit generally of requiring proof whenever it is possible to be obtained.

To suborn nature, and abuse knowledge, for the vulgar purpose of exciting surprise among the ignorant, can now never acquire more than a very short-lived success, and must, eventually, be productive of great humiliation.

Besides, there is abundantly sufficient among the grand, and even among the minute, operations and productions of nature, to satisfy the most ravenous appetite for the "wonderful" and the "new," without fabricating, or circulating, when fabricated by others, statements at utter variance with all known acts, and ushering them into the world in a manner tending to disturb that confidence in the constant uniformity in the laws of nature, which centuries of investigation have combined to produce, and upon which the philosophic mind reposes with satisfaction and delight.

Without meaning to impute ignoble motives to so eminent a philosopher, and so acute an observer, as Sir David Brewster, it is, at least, surprising to see him expose himself to a charge of this nature, and that, too, in a work whose very intention seemed to be the clearing of the mind's eye, the strengthening of its vision, and the increase, to borrow an astronomical phrase, of its penetrating power, so that it might pierce more thoroughly the mistiness which superstition and knavish cunning, sometimes for base, and frequently for criminal, purposes, envelop some simple, but little known operation of nature, or some refined, but only partially exposed, process of art. Sir David had also an abettor, if not an accomplice in the late Sir Walter Scott, but in him the love of mystification, and the practice of ingenious deception, were so predominant, that we rather wonder he was content to play so second-rate a part in the case which we are about to refer to.

In the "*Letters on Natural Magic*, addressed to Sir Walter Scott, Bart., by Sir David Brewster, K.H., LL.D., F.R.S., V.P.R.S.E., &c.." p. 255, &c., is the following passage:—

"One of the most remarkable and inexplicable experiments relative to the strength of the human frame, which you have yourself seen and admired, is that in which a heavy man is raised with the greatest facility, when he is lifted up the instant that his own lungs and those of the persons who raised him are inflated with air. This experiment was, I believe, first shown in England, a few years ago, by Major H., who saw it performed in a large party at Venice, under the direction of an officer of the American Navy. As Major H. perfomed it more than once in my presence, I shall describe, as nearly as possible, the method which he prescribed. The heaviest person in the party lies down upon two chairs, his legs being supported by the one, and his back by the other. Four persons, one at each leg, and one at each shoulder, then try to raise him, and they find his dead weight to be very great, from the difficulty they experience in supporting him. When he is replaced in the chair, each of the four persons takes hold of the body as before, and the person to be lifted gives two signals by clapping his hands. At the first signal, he himself and the four lifters begin to draw a long and full breath, and, when the inhalation is completed, or the lungs filled, the second signal is given for raising the person from the chair. To his own surprise, and that of his bearers, he rises with the greatest facility, as if he were no heavier than a feather. On several occasions, I have observed that when one of the bearers performs his part ill, by making the inhalation out of time, the part of the body which he tries to raise is left as it were behind. As you have repeatedly seen this experiment, and have performed the part both of the load and of the bearer, you can testify how remarkable the effects appear to all parties, and how complete is the conviction, either that the load has been lightened, or the bearer strengthened, by the prescribed process.

"At Venice, the experiment was performed in a much more imposing manner. The heaviest man in the party was raised and sustained upon the points of the fore-fingers of six persons. Major H. declared that the experiment would not succeed if the person lifted were placed upon a board, and the strength of the individuals applied to the board. He conceived it necessary that the bearers should communicate directly with the body to be raised. I have not had an opportunity of making any experiments relative to these curious facts; but, whether the general effect is an illusion, or the result of known or of new principles, the subject merits a careful investigation.

The circumstances under which this narration is given to the public are such, that if the feat, said to have been performed, was not so utterly incredible, they would be amply sufficient to procure for the "wonder," ready circulation and unhesitating acceptation even among scrupulous observers of truth. Here a Major H. is stated to have performed the experiment successfully in Sir David's presence; and Sir David Brewster, F.R.S., addressing Sir Walter Scott, F.R.S.E., speaks of the feat as one "*you have seen and admired*," describes the experiment as one "*you repeatedly have seen, and performed the part both of the load and the bearer*," and "*can testify how remarkable the effects appear to all parties*," &c.

As Sir Walter never in his life-time publicly noticed this appeal nor contradicted the statement, he united his testimony to that of Sir David, and as if even this united evidence could be strengthened, there comes "over sea" another circumstantial account of the same feat, and that from a quarter in which no confederacy could be suspected, unless indeed the American naval officer, who taught it to Major H., at Venice, had carried it across the Atlantic, and up the St. Lawrence. In an American periodical, *Silliman's Journal*, No. 57, published in April, 1835, there is the following communication to the Editor:—

Kingston, Upper Canada, October 31, 1834.
"Sir,—As a subscriber to your valuable journal, I take the liberty of asking of some of your scientific readers the rationale of the following experiment.

"An individual is to place himself on a stool or a table on his back, with his arms and legs crossed, keeping the whole body stiff; four or six others are then to place themselves at about equal distances, by the sides of the first,—say two at the shoulders, two about the middle of the body, and the others by the hips and thighs. Extending the fore-fingers of each hand so as to touch the body, somewhat underneath. At a given signal, the whole party are to take as full an inspiration as possible, and at another given signal, simultaneously to respire very slowly, gently pressing the body upwards at the same time, when it will be found to rise with a very slight effort, and to continue rising until the

breath is exhausted, when it will suddenly fall down with great force. The operators must be prepared for this circumstance, and immediately pass their arms under the body to break its fall; it will also be well for one individual to hold a pillow under the head for the same purpose. The experiment appears to succeed best in a closed room, and if the inspirations and respirations are not uniform, it will fail. I first saw it tried about twenty years ago, but have never yet heard or seen any satisfactory explanation of it.

"I am not aware that it involves any principle adverse to the known laws of gravitation, but it certainly appears for a short time to act independently of them. If you deem it (this letter) worthy of a passing notice, I should be glad to see it; if otherwise, let it be deposited in the Archives of the College of Laputa. "I am, Sir, respectfully yours,
"JAMES NICKALLS, Jr."

In this account respiration is one of the conditions, and the experiment differs in some other respects from SirDavid's, not materially, however; but so far as it does, the feat is rendered still more improbable. This gentleman also states that he "*saw it tried about twenty years*" before, and still, in 1834, "*he had never yet heard or seen any satisfactory explanation of it!*"

What shall be believed, then, of this extraordinary fact, so extensively promulgated in the Old Hemisphere, and echoed back from the New? We agree with the editor, in the journal above referred to, that "it is desirable that it should be decided either that the appearance is illusory, or that a reasonable cause should be assigned," and also with Sir David Brewster, who says, at the conclusion of the extract given, that "the subject merits a careful investigation."

We have the satisfaction of laying before our readers an investigation and decision, made with a most careful attention to all the circumstances described by Sir David Brewster. We have been permitted by an "Experimental Society," which holds its meetings in London, to have access to that part of their minute-book, in which the introduction and investigation of this very subject, and the final decision of the Society, are recorded. In order that the weight due to this investigation and decision may be properly estimated, we shall state, that though none of the members possess names which are to be compared with the splendour of those of the knight or of the baronet in question, yet some of them have distinguished themselves in the scientific world, and they all have a reputation for veracity, sufficient ability, habits of observation and patient inquiry, quite sufficient to qualify them to form a competent jury to try the question.

Though the members of this society systematically avoid notoriety as a body, the name of the members who assisted in this experiment may, in this particular case, be known, if any person should think it worth while to express the wish for them.

We also, for the same purpose of proving the confidence that may be placed in an investigation by these gentlemen, shall state shortly their mode of proceeding. When a subject is decided by them to be worthy of experiment, a director of the investigation is appointed, at whose command all the means that the society, as a body, or each individual so disposed, can furnish; and to avoid distraction and confusion, and ensure effective co-operation, his instructions are implicitly followed. At the conclusion of an experiment, made under these circumstances, the whole of the members present discuss the proceeding, and suggest any omissions they may have observed; if these are important, the experiment is repeated, and so on, until every doubt of every individual is removed, and unanimity obtained. This result cannot always be arrived at by one experiment, or in one meeting; it was not on the subject in question, but the process is repeated until it is accomplished.

It was under such a procedure that the fact described by Sir David Brewster was examined. Almost every member of the society was, at one time or other, "*the load or the bearer*," but particularly the heaviest and the lightest persons of the number were always lifted. As might be expected, the opinions were various in the first experiments. The differences however became less and less as the investigation went on and the proofs were multiplied; and at length they entirely vanished. The final unanimous verdict of the society being, that no such effect was produced as that described in the *Letters on Natural Magic*, that there was nothing whatever remarkable produced by the mode of lifting: and that the facility which was acquired in the lifting was no more than might be expected from the promptness which the bearers, by practice, acquired in acting uniformly together, upon a given signal. The feat of raising and supporting even their most minute member upon the fore-fingers of six persons, they found quite impracticable.

If this verdict should, by any accident, reach the ear of Sir David Brewster, and he should think any further trial necessary, we are authorized to say, that the "Experimental Society" wish it to be understood that they are ready to undertake it, under any modification that he may be kind enough to suggest; and, after following his instructions with the most scrupulous accuracy, to state the result to the public.*

Until some such re-agitation of the question should take place, we think after the above investigation, it must be admitted that the appearances described by Sir David Brewster were illusory and that no reasonable cause can be assigned which will produce such effects. We think, also, that

* Notwithstanding the conclusions at which the Experimental Society have arrived, we recommend to our readers a trial of the experiment, and they will be satisfied that the effects are really astonishing.—ED. *India Review*.

scientific men should abstain from giving currency to such monstrous improbabilities unaccompainied by refutation or explanatory remark. It would be far better to continue the inquiry into the cause, either of the fact or of the error, and abstain from publication until some satisfactory information had been obtained.

THE TRANSACTIONS OF THE LINNEAN SOCIETY OF LONDON.

vol. xvii.

The contents of this portion of the Transactions are,

A commentary on the fourth part of the Hortus Malabaricus. By (the late) Francis Hamilton, M.D. &c.

Memoir on the degree of selection exercised by plants, with regard to the earthy constituents presented to their absorbing surfaces. By Charles Daubeny, M. D. &c.

Review of the order of Hydrophylleae. By George Bentham, Esq. &c.

On Diopsis, a genus of Dypterous Insects, with descriptions of twenty-one species. By J. O. Westwood, Esq. &c.

The fact that about two-thirds of the half volume now before us are occupied with the fourth part of Dr. Hamilton's Commentary, which, however valuable, has already obtained its full share of the pages of the Linnean Transactions, must excite regret in those who are desirous for the prosperity of this very respectable Society, that its moderate funds should be thus drained, when a contribution from the ample means which it is well known the author possessed, could have so readily dispensed with this burden.

The object of the commentary is to remove the discordances in the nomenclature of Indian botany, particularly with regard to the adaptation of the native to the scientific names. The difficulties attending such an attempt are very numerous and complicated; because the native names are often indiscriminately applied to various species, when the latter approach each other in character or quality; and, in the east, where the vegetable kingdom is ransacked in all departments for the purpose of supplying a materia medica to the native physicians, these obstacles become more multifarious and perplexing than in more civilized parts of the earth, where, however, it may be alleged that the physical properties of plants are undervalued. Dr. Hamilton is inclined to consider the native names properly applied as exhibited in the following columns, which we have drawn up for the benefit of our friends in India, where our Journal is already perused :

Manga domestica	Mango Mao, or Mau
Catappa sylvestris	Ada maram
Myristica Malabarica	Panem palka
Barringtonia racemosa	Samstravadi
Stravadium acutangulum	Tsjeria Samstravadi
Holigarna longifolia	Katou Tsjerou
Terminalia, or Myrobalanus } Taria	Tani
Rumphia tiliæfolia	Tsjem Tani
Limonia monophylla?	Mal naregam
Randia virosa	Catu naregam
Limonia acidissima	Tsjerou Catou naregam
Vateria Indica	Paenoe, Paenu
Lansium?	Nyalel
Alangium decapetalum	Angolam, or Alangi
Hamiltonia?	Idou Moulli
Sapindus emarginatus	Poerinsii
Duabanga Sonneratoides	Duyabanga Adamboe
Lagerstroemia hirsuta	Catou Adamboe?
Eleocarpus perincara	Perin Cara
Mimusops hexandra?	Manil Cara
Alangium tomentosum	Dhela
Theka ternifolia	Theka
Wehera corymbosa	Katou Theka
Clerodendrum serratum	Tsjerou Theka
Cynometra ramiflora	Iripa
Rhus Odina	Kalesjam
Garuga pinnata,	Catu Calesjam
Schinus Saberia?	Ben Calesjam
,, Niara	Niyar
Papyrius, or Broussonelia } integrifolia	Ponga
Vitex leucoxylon	Karil
Cordia?	Vidi maram
Calophyllum inophyllum?	Ponna
,, Calaba?	Tsjerou ponna
Celtis orientalis	Mallam Toddali
,, Amboiensis	Tilayi
Celtis Acata	Acata
Zizyphus Mauritiana	Perim Toddal
Melastoma aspera	Kadali
,, Malabathrica?	Katou Kadali
Avicennia Oepata	Oepata
Guettarda ?	Rava Pou
Samyda Canziala	Kanjiala, Anavinga
,, piscicida	Konijal
,, glabra	Lohajang
?	Corondi
Sapium Indicum	Bengiri, Hurmayi
Melia integerrima	Ana Bepou
Camunium Bengalense	Bepu
Bergera integerrima	Ban Kongeha
Olea dioica	Kari Vetti
Agyneja multilocularis	Pee Vetti
Physalis Sugunda	Sugunda
Antidesma Zeylanica	Noeli Tali
,, paniculata	Amri
Calicarpa ?	Pontaletsje
Azalea ?	Modagam
Scaevola taccada	Taccada
,, lobelia } ,, Modagam }	Bella?
Sterculia guttata } ,, Balanghas }	Ramena Pua or Pou Maram?

According to Hamilton, the *Vateria Indica* produces the gum *anime* which Dr. Roxburgh says is termed in commerce, East Indian Copal. Schindler tells us that there are three kinds of Copal: 1. The East Indian, or African Copal, is the brightest and softest, and affords the best varnish. It is sometimes called *ball copal.* 2. The second variety is called West Indian or American Copal, being derived from the Antilles, Mexico, and North America, and is procured, according to Martius and Hayne, from different species of *Hymenea, Trachylobium,* and *Vouapa.* It is termed *stone copal,* and is yellower than the preceding kind. It comes to us in hard, flat pieces, weighing about three ounces. It is less easily melted than the preceding variety, and seldom contains insects. 3. The third variety is also termed West Indian copal, but might be mistaken for the first species, as it occurs in the form of convexo-concave pieces, eight ounces in weight. Taste aromatic. Melting point between that of the two preceding. Fresh oil of rosemary dissolves the first in

any proportion. Fresh oil of turpentine dissolves the first variety completely, but only dissolves a small portion of the other two, after long digestion. The action of alcohol is similar. Schindler terms the last species, for the sake of distinction, *insect copal.*

These facts I consider it proper to bring forward, because Dr. Hamilton denies that copal comes from India. Now, this opinion is at variance with the statement of Retzius, who called it *Elaeocarpus copalliferus*, because it afforded the gum copal. Dr. Roxburgh alleges also that the resin of the *Paenoe* is called East India copal. Mr. Turnbull of Mirzapore informed Dr. Hamilton that some which he sent home for trial would not sell for copal, although it was allowed to be *anime.* "The real copal and anime," he adds, "are American productions." The resin of the *Paenoe*, or *Dupa* (Vatena Indica) was probably used by the Brahmans of Malabar as an incense. The *Paenoe* is one of the finest ornamental trees in India; and in the province of Canara it is usually planted in rows by the sides of highways, making remarkably fine avenues. The statement of Mr. Turnbull is not conclusive, because he does not state that its rejection was the consequence of chemical examination.

The paper of Dr. Daubeny, who is professor of both the very extensive sciences of chemistry and botany, is devoted to an account of some researches carried on in prosecution of the curious facts pointed out by Schrader and others, who found that there was some reason to conclude that plants, in their assimilating processes, produced silica.

Their method of proceeding was first to burn the seeds and ascertain the quantity and nature of the residual earthy matter; then to sow a given portion of similar seeds in sulphur: and then to ascertain the nature of the earths contained in the ashes of the plant. Dr. Daubeny employed different soils, and instituted a comparison between the effects of each. The materials of the soils were sulphate of strontian, Carara marble, sea sand, and mould. The results do not appear to lead to any new inference. The author, however, concludes "that the roots of plants do, to a certain extent at least, possess a power of selection, and that the earthy constituents which form the basis of their solid parts, are determined as to *quality* by some primary law of nature, although their amount may depend upon the more or less abundant supply of the principles presented to them from without."

The order *Hydrophylleae* was first pointed out by Mr. Brown, in his *Prodromus Flor. Nov. Holl.* under which he included the genera *Hydrophyllum, Phacelia, et Ellisia,* and afterwards added *Nemophila and Eutoca.* Mr. Bentham, in the present paper, describes forty species belonging to these five genera, and a new one which he terms *Emmenanthe.* They all differ from their nearest allies, the *Borragineae*, in the capsular point, and copious albumen, and the structure of the ovarium. In the *Hydrophyllum, Nemophila,* and *Ellisia,* the placentæ are broad, fleshy, line the whole ovarium, adhere at the top and basis only, being free from the parietes, and bear on their inner surface, each of them, from two to sixteen ovulæ, placed in two vertical rows, one on each side of the central line.

In *Etoca, Phacelia,* and *Emmenanthe* the placentæ are linear, or slightly dilated, and adhere more or less to the parietes along their central line, bearing on their inner surface from two to fifty or sixty ovulæ.

I. *Hydrophyllum* comprehends the species, 1. *Appendiculatum,* from the Alleghanies; 2. *Canadense;* 3. *Virginicum;* 4. *Macrophyllum,* near the Columbia.

II. Ellisia. 1 *Nyctelea,* Potowmac and Missouri; 2. *Ambigua,* Missouri; 3. *Membranacea* California; 4. *Crysanthemifolia* California; 5. *Microcalyx;* 6. *Ranunculacea.*

III. Nemophila. 1. *Paviflora* Columbia; 2. *Pedunculata* Columbia; 3. *Phaceloides;* 4. *Aurita* California; 5. *Insignis* California 6. *Menziezii.*

IV. Eutoca. 1. *Douglasii* California; 2. *Cumingii* Chili; 3. *Brachyloba* California; 4. *Mexicana;* 5. *Parviflora* Pennsylvania, 6. *Loasaefolia* California; 7. *Franklinii;* 8. *Menziezii* California; 9. *Sericea;* 10 *Grandiflora* California; 11. *Divaricata* California, 12. *Phaceloides* California.

V. Phacelia. 1. *Malvaefolia* California; 2. *Brachyantia* Chili; 3. *Circinata* Columbia; 4. *Integrifolia* Platte; 5. *Ciliata* California; 6. *Ramosissima* California; 7. *Tanacetifolia* California; 8. *Bipinnitifida* Alleghanies; 9. *Fimbriata* Kentucky; 10. *Hirsuta;* 11. *Glabra.*

VI. *Emmenanthe Penduliflora Calaronia.*

Of these species 19 were sent from the western parts of North America, by the indefatigable Mr. Douglas, who, unfortunately, lost his life in the Sandwich Islands, during the prosecution of his botanical researches.

The chief interest of the genus *Diopsis* arises from the extraordinary elongation of the sides of the head into two cylindrical horns, which, in some instances, are as long as the whole body, and at the extremity of which, the eyes, of a semi-globular form, are placed. The antennae, also, are inserted near the extremity of these protuberances, at a short distance before the eyes. These horns, at first sight, might be mistaken for antennae, but they are inarticulated at the base, as well as along the surface; they have, therefore, no independent motion, their movements being, necessarily, accompanied by those of the whole head. When, however, we recollect that they contain not only the infinity of nerves of the compound eyes at their extremities, but also those producing the sensation, of which the antennae are the seat, we can easily imagine how necessary it is that the means of communication with the remainder of the head should be unbroken by articulation. Mr. Westwood describes 21 species: 1. *Ichneumonea* Guinea, 2. *Collaris* Senegal. 3. *Pallida.* 4. *Nigra* Sierra Leone. 5. *Apicalis* Sierra Leone.

6. *Tenuipes* Senegal. 7. *Indica* Bengal. 8. *Assimilis*. 9. *Abdominalis*. 10. *Fumipennis*. Senegal. 11. *Punctiger* West Africa. 12. *Signata* Sierra Leone. 13. *Fasciata*. 14. *Concolor* West Africa. 15. *Macrophthalma* Sierra Leone. 16. *Thoracica* West Africa. 17. *Obscura* Sierra Leone. 1. *Confusa* Congo, Sumatra. 19. *Dalmanni* Java. 20. *Sykesii* East Indies. 21. *Brevicornis* Pennsylvania.

This paper is illustrated by engravings of twenty figures.

CONSTANT VOLTAIC BATTERY.

Professor Daniel, of King's College, exhibited his battery on the 6th inst., at the Royal Institution. He was led to construct this very beautiful apparatus, by following up the investigations of Davy and Faraday. He found that the protecting power of tin on copper sheathing, was due to a chemical action. Thus he placed a plate of silver in a solution of sulphate of copper; and on touching it with a fine-pointed rod of zinc, he found the copper deposited on it in a circular form, and in a regular manner; and, if the contact was kept up, the whole plate was supplied with a copper coating. The effect of protecting metals appeared, at first, an objection to the chemical theory of electricity; but this experiment demonstrates its truth. To determine and measure the definite chemical action of electricity, Mr. Daniel has constructed a *dissected battery*. It consists of ten cylindrical glass vessels, which contain the fluid electrolytes; the two plates of metal are immersed in these fluids, each plate communicating below by means of a separate wire, which is made to perforate a glass stopper closing the bottom of the cell, with a small quantity of mercury contained in a separate cup below the stopper. The plates consisted of amalgamated zinc and platinum; the electrolyte consisted of 100 water, and 2·25 sulph. acid. He found that by increasing the size of the platinum plates, the action was promoted, and that the zinc might be reduced to the size of a wire, with the same effect as when a plate was used. Iron answers in place of the platinum, but not instead of zinc. The dilute acid described, has little action on the amalgamated zinc, because the latter becomes speedily covered with bubbles of hydrogen, which mar its action.—When nitric acid is added, the plate is soon dissolved, without extricating any gas, in consequence of the elements of the nitric acid combining with the nascent hydrogen. Nascent hydrogen also deoxidates copper. To remove the hydrogen, he constructed the *constant battery;* which consists of a copper cylindrical vessel, containing in its axis, a membranous tube formed of the œsophagus of an ox, in which is suspended a rod of zinc. Diluted acid is poured into the membranous tube, by means of a funnel; and passes off by a syphon, communicating with the bottom. The space between the animal tube and the sides of the copper cylinder, is filled with a solution of sulphate of copper, and pieces of this salt, to keep the solution saturated. By this arrangement, the oxide deposited is removed as it is formed, by the syphon tube; and the hydrogen evolved from the surface of the copper, is absorbed. For, on completing the circuit, the electric current passes freely through the blue vitriol solution, and no hydrogen appears on the conductor; but the latter is covered with a coating of pure copper. The advantages of this battery are obvious; it may be kept for hours in action, with the same power, and is economical.—*Records of Science, June,* 1836.

THE INDIA REVIEW.

Calcutta: October 15, 1836.

INDIA ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

When we witness the great number of well educated youths so well prepared for entering upon collegiate systems of study as at the High School, the Parental Academy, and the other seminaries at the Metropolis, it becomes a matter of regret that there is no institution in this city, to which the senior students can have access for the attainment of the higher branches of professional and scientific education. To supply the desideratum we understand it is in contemplation to build a theatre or lecture room, on extensive grounds, and to establish an Indian association for the advancement of science and mechanical arts. The chief aim of this institution is to qualify young men for the practice of the learned professions, as well as to teach practically the mechanical arts. The model is to be that of the French Ecole Polytechnique, which may, without doubt, be as successfully carried into execution in India as it was in France.

The Ecole Polytechnique took its rise under the auspices of Monge, Haüy, Hassenfrætz, La Place, La Grange, Fourcroy, Chaptal, Poney, and others. Other schools of science were also established. They had 1300 pupils, of whom different professors took charge in their respective sciences. The system was vast, and such was the progress and acquirement

of the pupils that they surpassed all expectations by which the confidence of the government and the public was secured, and the Ecole Polytechnique permanently established. At the risk of being thought rash as to our expectations, we trust such an institution may rise and that eventually a university also for India may be founded.

CAUTION TO THE PUBLIC.

Nux Vomica Bark sold in the bazars, as the Rohun, or Swietenia Febrifuga†.*

The above notice appeared in the *Bengal Hurkaru* on the 6th instant; and, as the following letter contains matter of deep interest, we are glad that we have an opportunity of giving it insertion in our present number.

The great importance of the facts I am about to describe, demands their immediate and general publication. I am consequently compelled to place them before the public in the ordinary journals.

The bark of the Rohun tree (Swietania Febrifuga) has long enjoyed considerable reputation as a remedy in the agues and remittent fevers of this country. Hopes were even entertained that it might yield on analysis an effectual substitute for the costly *Quinine*. To encourage the necessary researches, the Medical and Physical Society of Calcutta offered a prize of a gold medal to the discoverer of the desired sustance. In the course of the subsequent year Mr. Piddington announced that he had accomplished that great object, and he forwarded to the society details of the processes he employed, and by which he stated that he had procured the substance in question from the Rohun bark, (see vols. 4 and 5 of Transactions of the Medical and Physical Society.)

On my arrival in India in December, 1833, I was requested by the Society to repeat Mr. Piddington's experiments, and I was furnished by Dr. Wallich with the necessary quantity of the Rohun bark. My experiments did not corroborate Mr. Piddington's statements, and similar researches carried on at the H. C.'s Dispensary were equally ineffectual.

Mr. Piddington then declared that the Bark we examined was not the true Rohun, and he sent a specimen of what he considered to be the genuine Bark to the H. C.'s Dispensary. About the same time he sent samples, of a crystalline substance (the alleged new febrifuge) to the officers of the Dispensary. He also sent a minute portion of the same crystal, and a specimen of the bark from which he obtained them to my friend Mr. Hurry of Cossipore.

These crystals were immediately subjected to analysis by the officers of the Dispensary, who, in conjunction with Mr. Prinsep, declared them to be a compound of sulphuric acid and a *new vegetable alkali, the base of the Rohunna*, or Swietenia Febrifuga bark, (see India Journal of Medical Science, vol. I. p. 354.)

It may not be superfluous to mention that I was not favored with an opportunity of examining the substance in question. I state this in order to acquit myself before the public of responsibility for any possible casualties connected with the facts I am now about to describe.

On the 2d instant, while passing the day with Doctor Goodeve at Cossipore, I learned for the first time that Mr. Hurry had a portion of the "new" substance. He immediately placed it at my disposal, with a specimen of bark received from Mr. Piddington as the Rohun. We at once commenced its chemical examination.

The first test applied led me to the belief that the substance under trial was either of the formidable poisons *strychnine* or *brucine*. There was but little difficulty in deciding the important question, for these poisons in the minutest quantities produce symptoms so peculiar and terrible that they cannot be mistaken. The symptoms are violent tetanic spasms, occurring in paroxysms and proving fatal with fearful rapidity.

Mr. Hurry's specimen of Mr. Piddington's preparation weighed about 3 grains.

1st Expt. In presence of Mr. Hurry, Dr. Goodeve, and my brother Richard O'S., about one quarter of a grain was given to a kitten—in about 20 minutes violent spasms set in, and the animal died in one hour.

2d Expt. About one-tenth of a grain was introduced into a wound in the forepaw of a second kitten. In 40 minutes tetanic convulsions occurred, and the paroxysms continued for two hours, when the symptoms slowly subsided.

On the following morning I continued the enquiry in Calcutta. Some days before I had received from another quarter a few drachms of a very bitter black extract, marked "*Extract of Rohunna,*" which had been prepared for medical use in fever cases from bark purchased as Rohun in the bazar, according to a muster specimen stated to have been received from Mr. Piddington himself.

At 3 P. M., on the 3d instant, in presence of Dr. Cantor, my brother, Mr. Seyers, the Pundit Madoo Suddin Gooptu, and others, at the laboratory of the Medical College, the following experiments were performed.

1st. 10 grains of the alleged "extract of Rohunna" were dissolved in rain water and poured into the mouth of a full grown rabbit. The animal made a slight convulsive movement of its forelegs and instantaneously died.

2d. A similar solution of the Extract was made, and one half of it (5 grs.) was administered to a full grown rabbit. He seemed to suffer no inconvenience for five minutes, when he was suddenly seized with tetanus, which proved fatal in less than one minute more. Dr. Goodeve was present at this experiment as well as the gentlemen above mentioned.

The necessary chemical investigations were meanwhile proceeding, and an application made to Dr. Wallich with reference to the identification of the bark, which, from the first experiment on the extract, I had no doubt was that of the Nux Vomica tree. I shall however continue the narrative of the experiments which demonstrated the true character of the poison under examination.

At 8 A. M. on the morning of the 4th instant my brother and I gave 10 grs. of the same extract to a sheep. He did not seem to suffer until 9 A.M. when a second dose of 10 grs. was given. In seven minutes the poor animal was seized with tetanus, and it died in fifteen minutes more.

Lastly, at 29 minutes past 2 P. M. on the same day at the Medical College, in presence of Dr. Bramley, Captain Birch, my brother, Mr. Seyers, and others, a solution containing 20 grs. of the extract was poured into the mouth of a pariah dog, one half at least was immediately rejected, nevertheless, in eight minutes the animal was seized with convulsions and in seven minutes more it died.

It would have been needless in humanity to have continued these reseaches further. They proved *indisputably*, 1st, that the crystals and the extract are powerful poisons and of the same kind; 2dly,

* Kuchila *(Bengali).* Kupilu *(Sanscrit).*
† Rahana *(Bengali)* Rohitaka *(Sanscrit).*

that the active agent is either Strychnine or Brucine; and 3dly, they led to the inference, that the Bark from which both crystals and extract were prepared was that of the Vomica or Poison nut of Bengal.

The *Botanical* and *Chemical* links of the investigation were quickly supplied. I stated that I sent Dr. Wallich a portion of the Bark received by Mr. Hurry from Mr. Piddington. I subjoin Dr. Wallich's reply to my communication :—

Botanical Garden, 3d October.

MY DEAR O'SHAUGHNESSY,—There is not the slightest doubt in my mind, that the specimen of Bark you sent me is of *Strychnos* Nux Vomica. I send you samples of the fresh Bark which will at once convince you of my assertion. But taste the bark and you will perceive in it the same strong bitterness joined to a most disagreeable sort of pungency as there is in your own specimen, which I retain having taken the liberty to keep a small bit of it.

Your's, &c.
N. WALLICH.

On comparing the physical and chemical properties of the three barks; No. 1, given by Mr. Piddington to Mr. Hurry; No. 2, from which the extract used in the above experiments was made; and No. 3, that sent by Dr. Wallich in reply to my note, not the slightest doubt as to their perfect identity can, for one moment, be entertained.

Lastly, as to the *chemical nature* of the crystals termed "Sulphate of Rohunna" by Mr. Piddington and the writers in the "*India Journal of Medical Science*," the substance proves to be a mixture of *Brucine*, *Strychine*, and adhering coloring matter, with faint traces of the sulphuric acid employed in the preparation. For the satisfaction of gentlemen who understand these matters practically, I may state, that the crystals become blood red when touched with nitric acid, that protochloride of tin changes this red gradually and slowly to a beautiful violet (This experiment was witnessed by Dr. Bramley and Mr. Hare, and proves the presence of *Brucine*), that hydro-sulphate of ammonia added cautiously and in minute quantities to the reddened crystals changes them to a violet blue, indicating *Strychnine*.

The extract above alluded to on analyses afforded both the bases in question. The three barks lastly agree in all their chemical characters and afford unequivocal proof of the presence of Strychnine and its associate the igasuric acid.

It is a curious fact that the bark which Mr. Piddington supposed to be that of the Swietenia (from which nevertheless it is totally different in color, taste, consistence, and chemical properties) is now proved to be the same, which, under the name of false Angustura was introduced into Europe many years since, and caused so many calamitous accidents, that the Austrian Government and several other powers seized and destroyed all that could be found in their territories.

As it is my intention to publish minute details of this remarkable occurrence in a professional periodical: there remains little more of this disagreeable task to perform, than to give a sufficient description of the characters of the true Rohun and of its fearful substitute, as will enable the public to guard against the fatal accidents which must inevitably follow the incautious use of the latter.

True Rohun.	*Nux Vomica Bark.*
Externally gray, substance red, consistence loose, texture flexible, taste slightly bitter and austere. Powder coarse and red, solution in in water color of bark, not affected by nitric acid.	Externally gray, internally deep brown or black. sometimes covered with rust colored fungi, consistence brittle, taste insupportably bitter, powder grey, solution in water yellowish, bark stained blood red when touched with nitric acid.

Specimens may be seen at the Medical College daily from 11 A. M. to 4 P. M.

I here dismiss the subject for the present without comment or animadversion: it is painful to me to bring it forward at all; but it would be criminal to shrink from the performance of such an urgent duty.

WM. B. O'SHAUGHNESSY, M. D.
Professor of Chemistry, Medical College.
5th October, 1836.

P. S.—I annex a copy of a report from Mr. Foy on experiments on two dogs made this morning at the General Hospital by direction of the medical officers of that establishment.

TO DUNCAN STEWART, ESQ. MD.

SIR.—The dog to which was administered one drachm of the extract was first convulsed one hour and twelve minutes after, and after a few rapid and strong fits of convulsion died in one hour and thirty-one minutes.

The dog which got half a drachm of the extract became convulsed 30 minutes after, and, after several fits of tetanic convulsions, died one hour and two minutes after.

WILLIAM FOY, *Apothecary*.

I have only to observe on this experiment that the extract was given to those animals in the solid form.

5th October, 1836. *W. B. O'S.*

With the view of making ourselves fully acquainted with the foregoing important subject, we attended at the College, and Dr. O'Shaughnessy, in our presence, again performed the experiments to which he has alluded. We are satisfied in our own mind that this bark is the same as that examined by Planche, who named it angustura ferruginea, which, he said, contained brucine. It is also alluded to by Orfila among the class of substances which excite violent paroxysms of convulsions and tetanus. Dr. Rambach of Hamburgh first distinguished two kinds of angustura bark; one of which he called poisonous. That which was genuine was called West Indian; but the poisonous one he called East Indian angustura. This statement was adopted by Pfaff and other German authors on Materia Medica. Both kinds are often in commerce mixed together; and, in consequence of the fatal effects, from the use of spurious angustura in Hungary and Bern, proof of which was obtained from its poisonous effects on animals (Traité des Poisons, Paris, 1817), the Austrian Government ordered all angustura bark in the empire, genuine and spurious, to be burnt, and interdicted its future importation. Its sale was also prohibited in Denmark, in Russia, and in Wirtemberg. Although it be acknowledged that the results alluded to proved the poisonous effects of

this bark, we are far from wishing a similar prohibition here, seeing that a preparation from it may supply a safer and milder remedy than we already possess in genuine strychnine. Although we hear that there are no just grounds for supposing that the natives have sold nux vomica bark in the bazar as the rohun or swietenia febrifuga when these articles have been separately required, yet it appears to us highly necessary that the sellers of drugs should without delay be warned of the poisonous nature of the bark. The expediency of licensing the venders of drugs, which require such nice distinctions to discover the genuine from the spurious barks, is in our opinion a subject worthy the consideration of the legislature. The Medical Faculty of Vienna had found that dogs and rabbits were not affected by large doses of genuine angustura, but were speedily killed by small doses of the spurious kind given internally. Drs. Rambach, Pfaff, and Planche give the following characters, which they deemed sufficient to enable persons to distinguish the genuine from the poisonous angustura.

Genuine.

The produce of the *Bonplandia trifoliata* of Humboldt, a native of South America.

Size from ½ to ⅝ of an inch broad; 2, 3, or 4 inches long; half a line thick. Outer surface uniform greyish white, as if covered with an uneven mealy coat, which is easily removed, and exposes a brown surface beneath. Inner surface greyish-yellow, or light-brown. Texture fine; very brittle. Fracture even; much darker and browner than the inner surface; somewhat shining, and evidently resinous.

Smell, aromatic; somewhat nauseous.

Taste aromatic bitter, but not at all disgustingly bitter, or astringent, succeeded in some degree by an aromatic flavour like mace.

Bark, on being chewed, becomes dark brown-yellow. Powder, when fresh, yellow, like good rhubarb, becoming paler by keeping, with a more aromatic smell than the bark.

Concentrated infusion, clear, of a fine reddish brown or orange colour, and a bitter, only slightly acrid, taste.

Diluted with water, its colour becomes yellow.

On the addition of an alkaline carbonate, it is changed to dark red, and after some time deposit a clear citron yellow, somewhat flocculent, precipitate.

A solution of persulphat or permuriat of iron imparts to it a higher red colour, and after some time throws down a rose-coloured precipitate.

Is not rendered turbid by solution of gelatine.

Saturated decoction of a fine redbrown, on cooling becomes turbid, and deposits a deep yellow powder.

Saturated tincture, dark red-brown, becoming very turbid by the addition of distilled water, and depositing a clear yellow resin.

Spurious.

Unknown. Said by some to come from the East Indies; and one kind suspected by *Planche*, but, contrary to probability, to be got from a variety of the *Cinchona magnifolia* of Bonpland.

Size generally of greater breadth than length; two lines thick. Outer surface covered with a web of distinct small white warts, not easily removed, or with an uniform rust-coloured lichen-like covering. Inner surface, dirty yellowish white, or grey, or most commonly black, without visible fibres. Texture coarse; very brittle. Fracture even; partly white, or yellowish-white, or even clear brownish; not shining and resinous, but more mealy, and partly exhibiting two distinct layers.

Smell, resembling somewhat that of the genuine kind

Taste, in the highest degree disgustingly bitter, very durable, and not at all aromatic, or astringent.

Bark, on being chewed, becomes paler. Powder clearer yellow

Concentrated infusion, not so clear, more of a dirty brown colour, and of a most disgustingly bitter taste.

When diluted, it does not become yellow.

On the addition of an alkaline carbonate, it becomes greenish, and deposits a flocculent greyish yellow precipitate, and the supernatant liquor becomes gradually dark brown, beginning at the surface.

A solution of persulphat or permuriat of iron imparts to it a dark-green colour, and soon throws down a copious satin black precipitate verging somewhat to ash grey, which is perfectly re-dissolved by nitric acid, and forms an olive solution.

Is not rendered turbid by solution of gelatine.

Saturated decoction, brownish-yellow, and, on cooling, deposits a very copious grey-brown precipitate.

Saturated tincture, much paler: and, on the addition of distilled water, only gets a pale-yellowish opaline appearance, without becoming red, or depositing any precipitate.

We have been favored with the following from Dr. Jackson, the Apothecary General, on some experiments performed by him.

"The first pig got a drachm* dissolved in one oz. of distilled water; so much was lost in giving it, that I repeated the same quantity before this was well down: he died violently convulsent.

The second was punctured in the cellular membrane in the inside of the thigh: 15 grs. in 2 drs. of water were injected, which producing no apparent effect in 15 minutes, ½ a drachm dissolved in ½ an oz. of water was administered; of this ¼ was lost in swallowing: in about a minute and a half convulsive twitches at first confined to the abdominal and muscles about the throat, were perceived, then relaxed, and were succeeded in about two minutes by a tetanic state of the whole body, exhibiting a complete state of rigidity from the mouth to the tail which was extended like a riding switch. This alternate state of spasm and relaxation occurred till the 11th minute, when, as the last spasm was off, she expired passing urine at the time. The first did not do so having been so instantaneously, and having itself emptied its bladder it came into the yard.

Professor Emmert of Tübingen published an account of the poisonous effects of the bark of the angustura pseudo-ferruginea, or spurious angustura bark owing to its physical properties and effects, he refers its botanical origin, to the genus Strychnos; and, by comparing what has hitherto been mentioned with the known effects of other poi-

* The extract.

sons, and the principles of physiology, he was led to the following results as to the manner in which this poison acts, and its chemical nature.

1. The poisonous angustura shews, with respect to the effects that it produces on animal bodies, the greatest analogy to the poisonous species of strychnos, viz. Strychnos *nux vomica*, Strychnos *ignatii*, and Upas *tieuté*.

2. With regard to the part of the animal body it affects, and the circumstances under which it operates, it agrees perfectly with most other poisons, as arsenic, barytes, tartarus emeticus, white hellebore, viper poison, sulphuretted hydrogen, opium, spiritus vini, prussic acid, and the poisons containing it, as the oil of bitter almonds, the prunus *lauro cerasus*, and *padus*, and the above-mentioned poisonous species of strychnos, the upas *antiar*; and the American arrow poisons, as ticuna, lama, and woorara.

3. It exerts its fatal influence by penetrating the coats of the blood-vessels, mixing immediately with the blood, and then, by means of the circulation, affecting the spinal marrow in a manner destructive and mortal to the whole body. The absorption of the poison has no share in its effects, and all local effects produced by it, proceed only from the affection of the spinal marrow.

4. The action of this poison, like that of the species of strychnos, seems to depend on a combination analogous to prussic acid: for bitter angustura and those species of strychnos (and generally if not all, at least most vegetable poisons) contain, like prussic acid, a great deal of azote; it has also, in common with the latter, and the poisons containing prussic acid, the bitter taste which is very distinct in bitter almonds; and which, in these, does not proceed from extractive matter, as Pfaff contends, but from an etherial oil, as they altogether lose it when the latter is dissipated. The poisonous species of strychnos afford besides, by the salts of iron, a change of colour and precipitation, like prussic acid; and I find, by my latest investigatation, that water distilled over bitter almonds, indeed, partly loses its poisonous properties, by precipitating the prussic acid by means of salts of iron (just as bitter poisons do by the absence of that part which forms with the iron a dark green precipitate,), but not entirely, like the water impregnated with prussic acid, or prussiated alcohol; and that, when digested with iron and alcali, it has the property of always reproducing new prussic acid. The dark greenish precipitate, which the bitter poisons produce when combined with the salts of iron, contains indeed no proper prussic acid, and is in other respects different from Prussian blue; but it consists, like the other, of a constituent matter and iron, and seems, like this, to be innoxious to animal bodies,; besides, free liquid prussic acid produces, with the salts of iron, precipitates, which likewise differ from Prussian blue, and seem to indicate some modifications of prussic acid.

The following fact seems, however, still more strongly to militate in favour of such a chemical composition of the bitter poisonous matter. I have observed, that that remarkable bitter substance which is obtained, after Welter and other chemists, from amimal and other bitter substances similar to them, if treated in a warm atmosphere with nitric acid, has an influence on animal life similar to that of bitter angustura; for this *amère* nearly agrees in its chemical composition with prussic acid.

We may remark, also, in this respect that opium, but especially all arrow poisons, have a strongly bitter taste; and that, according to the excellent investigation of Majendie and Delile, all bitter species of strychnos are poisonous; those, on the other hand, that are not bitter, like strychnos *potatorum* and *vontac*, are innoxious; and, according to Leschenault, the interior of the root of strychnos *tieuté*, the external bitter bark of which furnishes the strongest upas poison, is tasteless, and free from all pernicious properties. Many kinds of quassia *amara* are also poisonous for birds, lizards, and flies, (upon which animals only I have hitherto tried them); and especially all those are poisons which produce, with the salts of iron, a steel grey precipitate; and lastly, according to late observations, a red gentian root occurring in trade, has shewn narcotic properties*. All these circumstances render it probable, that most vegetable poisons contain a substance similar to prussic acid, and that the simple constituents of it form a series of combinations which have the same relation to prussic acid which the vegetable acids have to acetic acid.

The fatally poisonous property of putrid black puddings, which has been confirmed by late melancholy instances, depends perhaps on something similar. The poison, however, which is produced in black puddings seems, more nearly to approach to the rancid acidity to which also vegetable oils are liable, as the symptoms which attend its operations are similar to those produced by arsenic and copper†.

Mr. BRAMLEY'S INTRODUCTORY LECTURE

Was delivered on the 6th instant, at which were present the Right Honourable the Governor General, the Honourable Mr. Shakespear, and a crowded audience. It embraced a lucid exposition of the value of the study of anatomy, a perfect knowledge of which was to be acquired in the dissecting room only. Without this knowledge no man could become a thoroughly enlightened practical surgeon and physician; the studies of both were precisely the same and were inseparably connected; and, having enlarged upon the value and importance of the study of medicine with reference to the happiness and comforts of mankind, he concluded by exhorting his pupils to look to himself and his colleagues not in the heartless relation of teachers to them, but as connected by more endearing ties, having embarked in one self-same cause, mutually and cordially co-operating to attain one great and important end.

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* *Neues Berlinesches Jahrbuch fur Pharmacie von Dobereiner*, Berlin, 1811. 869.

† If black puddings, which are a compound of animal and vegetable matters, in a putrid state possess poisonous properties, does it not confirm Dr. Burrows' hypothesis, that putrefaction is the real cause of the poisonous qualities found in various fishes?—Vide London Medical *Repository*, vol. iii. p. 467-8.

QUARTERLY JOURNAL OF THE MEDICAL & PHYSICAL SOCIETY.

When this journal was proposed and ordered to be published at the last meeting of the Society, we understood that the intention was to publish the Transactions quarterly instead of annually, and to notice the proceedings and works the Society might receive,—an arrangement we thought exceedingly good; but the advertisement on the 3rd, and the editorial in the *Englishman* of the 4th, have convinced us that the Quarterly is arrayed against the *India Journal of Medical Science*, the editor of which begs to say that, notwithstanding the mighty power and wealth of a Society, he intends to stand his ground, and to shew cause enough for doing so in his forthcoming number. But as the Editor of the *Englishman* would usher in the Quarterly by detracting from the merits of the monthly, we have deemed it right to give the opinion of the Indian Press, on the merits of the *India Journal of Medical and Physical Science.* We refer the readers to our advertising columns, and beg they will compare the following extracts from the editorials of the *Englishman* with what the editor published on the 4th. We, who had so enchanted our contemporary, little expected he could so soon cast us away to rush into the embraces of a stranger; but, alas! he is like all faithless lovers.

The Englishman, June 2d, 1835.

"The *India Journal of Medical Science* for the present month (published yesterday) contains many interesting articles, adapted to a diversity of tastes, of which we shall employ to variegate our pages in a day or two: we are sorry however to observe, by the following notice, that Messrs. Grant and Pearson have abandoned the editorial vocation, bequeathing it with all its cares and honors to Dr. Corbyn, a gentleman of whose writings we have seen enough to satisfy us that the seceding parties have provided their readers with a worthy and fitting successor."

The Englishman, Friday, July 3, 1835.

"If Mr. Corbyn proceeds thus in his editorial vocation, there is no fear but that he will go on and prosper; and that his work will long continue, what its name proclaims it to be, *The India Journal of Medical Science.*

The Englishman, Thursday, March, 3d 1836.

Page 428. "The recent proposition to establish an opposition Journal must fall to the ground. We know enough of the labor and anxiety of mind required in the management of a medical work to be convinced that no person will carry one on, for any great length of time, unless he is paid either by money or renown. A society's Journal offers neither the one nor the other to its ex-officio editor; and, if by any extraordinary chance, it should succeed in putting down Mr. Corbyn's publication, it would of itself die a natural death in less than twelve months afterwards. The profession has to choose only between the present Journal or none."

The Englishman, Monday, April 1st. 1836.

Page 644. "We should do great injustice to Dr. Corbyn's industry and zeal were we to omit to bestow some attention upon the pretensions of the *India Journal of Medical Science* for the present month. The worthy editor has evidently been excited by the threats of the Medical and Physical Society to publish a Journal of their own, and, in a spirit of defiance, which we are disposed to admire, because it accords with our own notices of what should be the tactique on these occasions, produces a periodical unrivalled, and, we believe, unrivallable in India, for its variety and intelligence."

MEDICAL COLLEGE.

The winter session for 1836 and 37 opened on the 6th of October. Anatomy, Physiology, and observations on Surgery, from October 6 to March 31, on Mondays, Tuesdays, Wednesdays, and Fridays, at 10 A. M.

M. J. Bramley and H. H. Goodeve, Materia Medica and Pharmacy, from 1st November to February 28, on Tuesdays and Thursdays, 3 P. M.

W. B. O'Shaughnessy, Surgery, from 5th December to April 30, on Mondays and Wednesdays, at half past 12 o'clock.

Examinations on Saturdays, at 12 o'clock.

DR. SMITH.—The talented Editor of the Boston Medical and Surgical Journal and other scientific works has written to us for the skulls of animals peculiar to India.

We shall esteem it a favor if any of our brethren will enable us to comply with this request. Dr. Smith has promised to return similar preparations—minerals, shells, &c. and thus become the medium of scientific communication between scientific men in America and India.

MR. ROYLE.—We cannot but lament over the loss which science has sustained in India by the retirement of that distinguished individual Mr. Royle. Is the mere professorship of materia medica at the London University sufficient to wean Mr. Royle from the H. C. Service, who had only a few years to serve for his pension. Really this must, we should think, convince the home authorities as to the present state of their medical service in India, and determine them to do something to induce men of scientific acquirements to remain in it.

A QUARTERLY MEETING OF THE MEDICAL RETIRING FUND took place at the Secretary's quarters on the 10th. A report which will be published was read and adopted, when the feasibility of carrying our proposition of extending payment of arrears for 3 years was discussed, and it was decided that the meeting approve of the indulgence already granted by the committee of management for extending the payment of arrears, which of course authorized its continuance at the discretion of the committee of management rendering the distinct resolution made by us no longer necessary. Sixty new subscribers are recorded as having been added to the fund since the last Quarterly Meeting, and three anuities were to be at once declared.

PROGRESS OF SCIENCE,

AS APPLICABLE TO THE ARTS AND MANUFACTURES; TO COMMERCE AND TO AGRICULTURE.

MARTIN'S SAFETY-LAMP.

FIG. 2.

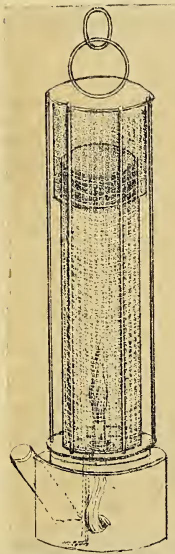
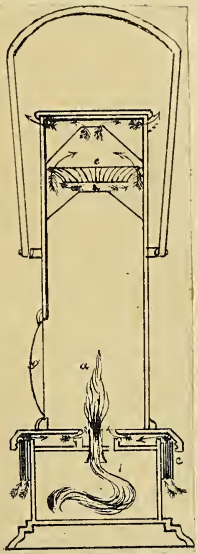
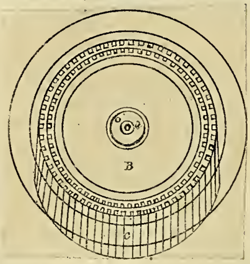


FIG. 1.



Sir,—Mr. John Martin, the eminent artist, submitted to the late Committee of the House of Commons on Mines, a plan of a safety-lamp, which, though it is not noticed in their Report, and was not alluded to in the trial at the London University, seems to me to be possessed of considerable merit. Fig. 1, of the accompanying sketches, is a sectional view of this lamp: and the better to show its superiority to the common Davy-lamp, an engraving of the latter (fig. 2) is placed by the side of it. *a* represents the wick, which should never be raised so high as to cause the flame to smoke; *b* is the oil chamber; *c* are grooved cylinders (shown more clearly in fig. 3),



which are of such diameters as only to admit air enough to support the flame. The advantage which these grooves (the master-feature of invention) have over wire-gauze or thin perforated plates, is, that the air has to pass through a body of metal; a principle the safety of which will be at once acknowledged by your scientific readers. *d* is a copper top, with an opening of the same size as that round the

flame; *e*, the break; *f*, places for the heated air to escape by, and through which the foul air cannot enter; *g*, a lens to cast the light into those parts where the air is so foul as to cause the lamp to go out; *h*, handle of the lamp, on the principle of the universal joint. Submitting the above to the impartial consideration of your readers,

I am, Sir,
Your obedient servant,
POLLSA.

THE NEW SAFETY CAB.

We extract the following clear and sensible exposition of the advantages of this new vehicle (the invention of Mr. Hansom, the architect of the Birmingham Town-hall, confessedly one of the finest architectural productions of modern times), from the prospectus of a company which has been formed for promoting its introduction into the metropolis:—

"The very peculiar construction of this carriage secures advantages that men of science and of practical experience have long wished for, but which have never before been obtained. Instead of an axle going through from side to side of the carriage, Mr. Hansom uses a framework, so contrived, that, while fully able to sustain any shock to which it may be exposed, and admitting the use of wheels of any diameter, it allows the body to be placed at any distance, however small, from the ground. By this contrivance, three most important objects are attained; namely—

"1st. *Absolute safety:* for the body is placed so low, and the framework so arranged, as to render it impossible that the carriage should be upset in any direction whatever; nor can a kicking, a rearing, or a stumbling horse place the passengers in danger.

"2d. *Great relief to the horse in peculiar situations*: for the centre of gravity of the load being placed below the centre of the wheels, the injurious pressure on the horse, in ascending and descending hills with a 2-wheel carriage of the common construction, is avoided; for, in descending, the pressure on his back is entirely removed; while, in ascending, a small and advantageous addition is made to it.

"3d. *Considerable reduction of draught in all circumstances*: for wheels of larger diameter than usual may be employed, not only without prejudice to the other advantages of the invention, but in promotion of them; and it is on all hands agreed, that very great saving of draught might be effected by the use of large wheels, but for the hitherto supposed impossibility of reconciling them with the other necessary properties and conveniences of a carriage.

* * * * * *

"The inconvenience and danger of the present cabs have been long, loudly, and justly complained of. The new cab is perfectly and obviously safe, and effectually protects passengers from injury by a vicious or stumbling horse; it affords ingress and egress as safe and easy as those of a sedan-chair, and is smoother of motion than many of the best carriages of other kinds; it also combines the shelter and comfort of a close carriage, with the lightness of an open one, and the speed of the best of the present cabs, at the cost of perhaps one-third less labour to the horse, and with the entire avoidance of the injurious effect of common 2-wheel carriages on hilly roads.

* * * * * *

"In ascents and descents, any moderate degree of safety to the passenger, or of pressure on the horse, has been, hitherto, attainable only by the use of four wheels. Where four are used, they cannot be large: much power is thus lost—to say nothing of the additional friction—and two horses are needed. Absolute safety, and greater comfort to the passengers, and much greater ease to the animal, are now secured by two wheels, and those large ones. The additional horse is thus dispensed with, and posting may be done by one horse, on terms and with a convenience and rapidity yet unaccomplished. The conveyance of mails and dispatches may be done by 2-horse carriages, with the like, or even greater, benefit.

"A carriage has recently been built, and is ready for public inspection and trial, which exemplifies the plan, and fully justifies the preceding observations. It has been subjected to severe trials, both intentionally and by accident; and, by coming out of them without the slightest failure, has proved that its framework may be safely relied on in any emergency."

ELECTRICAL SHOCK FROM A SHEET OF PAPER.

Place an iron japanned tea tray on a dry, clean beaker-glass, then take a sheet of foolscap writing-paper, and hold it close to the fire until all its hygrometric moisture is dissipated, but not so as to scorch it; in this state it is one of the finest electrics we have. Hold one end down on a table with the finger and thumb, and give it about a dozen strokes with a large piece of India-rubber from the left to the right, beginning at the top. Now take it up by two of the corners and bring it over the tray, and it will fall down on it like a stone; if one finger be now brought under the tray, a sensible shock will be felt. Now lay a needle on the tray with its point projecting outwards, remove the paper, and a star sign of the negative electricity will be seen; return the paper, and the positive brush will appear. In fact, it forms a very good extemporaneous electrophorus, which will give a spark an inch long, and strong enough to set fire to some combustible bodies, and to exhibit all the electric phenomena not requiring coated surfaces. If four beaker-glasses are placed on the floor, and a book laid on them, a person may stand on them insulated; if he then holds the tray vertically, the paper will adhere strongly to it, and sparks may be drawn from any part of his body, or he may draw sparks from any other person, as the case may be; or he may set fire to some inflammable bodies by touching them with a piece of ice.

I beg to remain,
Yours, &c.
G. DAKIN.

VEGETABLE OILS.

(From Report of the Commissioners of Excise Inquiry.)

Customs' Duties on the Raw Materials.

Although the instructions contained in our commission do not lead us to the examination of the Customs' duties on the raw materials employed in the manufacture of soap, we trust that we shall not be considered as exceeding the proper line of our duty by calling attention to the remarks of the deputation, as well as of Mr. Fincham and Mr. Taylor, as also of Mr. Tennant of Glasgow, upon the great disadvantages to which the manufacturer is exposed from the heavy duties on importation, to which the *vegetable oils* are still liable. These oils would enter largely into the composition of soap, if their price were not so much increased by these duties, which amount on some descriptions to a virtual prohibition of their use. The French, at Marseilles, employ olive oil exclusively in their soap; and in that town alone a quantity is made very nearly equalling the consumption of Great Britain. According to Mr. Tennant, the soap made from olive oil is better than that which is made from palm oil; and if the present duty of 4*l.* 4*s.* per ton on the former could be materially reduced, there seems to be every probability that after the abolition of the present restrictions on the manufacture, such improvements would be introduced as would enable us to rival, and probably to surpass, the French in the North American market. Our manufactures are now placed in so disadvantageous a situation as compared with the French and other makers, that it is very difficult for them to contend with them in the foreign markets; and even if the restrictions imposed by the Excise on the process of manufacture were removed, they would still suffer considerably from the duties on the materials which they employ, and on which no drawback is allowed; and it must be remembered that the difficulties under which the trade labour on this account have been materially increased by the discontinuance of the allowance of the tenths, to which we have already alluded.

The representations which were made to us on this head appeared to be so much deserving of attention, that we were induced to request the attendance of Mr. Crawfurd (the late resident at Singapore, and the author of a valuable work on the Indian Archipelago), for the purpose of obtaining such information as he could furnish with respect to the supply of those vegetable oils which might be obtained from the East Indies. Mr. Crawfurd appears to have directed his attention, during a long residence in India, very closely to the productions of that country, with a view of extending its commerce with Great Britain, and it will be seen from his evidence, that a very large field may be opened for a mutual trade, especially with reference to the articles more particularly wanted for the manufacture of soap. He states, that there are no less than fifteen *plants* in ordinary cultivation, in the continent and islands of India, from which an abundant supply of oil is obtained for the purposes of food and light; and he adds, that, from the general facility with which this cultivation may be extended, he sees no limits to the quantity which may be furnished for the demands of this country. He particularly points out the advantage which may be derived from the cultivation of the Palma Christi, or castor-oil plant, which grows in any soil, however barren, and yields a most abundant crop of oil.

* * * *

The present rate of duty on castor-oil, sesamum, cocoa-nut, palm-oil, poppy-oil, mustard, and pig-nut oil, and the amount received for the last five years, will be found in the appendix. The *ad valorem* duty on pig-nuts, sesamum, and poppy-seed, and on the oil made from them, is so high (viz. 20 and 50 per cent.) as to amount to a virtual prohibition of their extensive employment in any branch of manufacture. The duty on castor-oil "from any British possession, but not the produce thereof," is also so high as to prevent its use in manufactures. We are aware of the reductions which have been lately made in the duties on some of the vegetable oils; but it has been almost impossible for the manufactures to avail themselves of these reductions, on account of the Excise regulations. When these are removed, we anticipate the best effects from these reductions.

Our other trades and manufactures, the materials of which are subject to import duties, are not so much injured by them as to deprive us of the means of carrying on a profitable competition in foreign markets. But our inferiority in the manufacture of soap, in so far as it arises from the duties on oils, gives the foreign manufacturer the power of excluding us from large portions of the globe, and this certainly is a state of things from which so important a manufacture ought to be relieved. We feel it to be our duty not to lose this opportunity of again representing the strong impression which has so often been made upon us by the consequences of the impolicy of taxing the raw materials of industry, because we are fully satisfied that our commercial and manufacturing prosperity, great as it is, would be still more increased if the principle of exempting all raw materials from taxation were strictly adhered to. Whatever the loss of revenue might be which would take place in consequence of repealing these duties, it would soon be made good by the additional means of payment which would follow from increased national wealth.

PRESERVATION OF COPPER SHEATHING.

Sir,—The following method of preserving copper under ship's bottoms, for a considerably longer time than usual, is, I believe, but little known :—

Tar from wood or tar from coal contains a quantity of acid, which is a par-

ticular enemy to metals; this is shown in chemistry, in the course of manufacturing white lead, red lead, verdigris, and other colours, which are made by evaporation of acid, or its combination, with mineral substances. If this acid, which exists in the wood of the ship's bottom, in the tar wherewith the bottom is payed, and in the tar in which the paper or felt is soaked, can be got rid of, it is evident that the copper sheathing would last much longer. Some years ago, the copper covering of a house in the Royal dock-yard at Carlscrona, Sweden, being stripped off in the course of making some repairs, a quantity of lime-paste was found laid under a few of the plates, which were in an excellent state of preservation, and apparently likely to have lasted double the time of the others. Professor Berzelius, of Stockholm, the eminent chemist, when asked the cause of this, explained that nothing neutralises or kills the acid from wood so effectually as lime. Now, I am of opinion, that if paper or felt were soaked in a mixture of boiled oil, and as much slacked lime as the oil conveniently could contain, it would make a ship's copper bottom last for double the usual time. If oil be considered a too expensive article, the lime may be mixed with tar; but this would not be so effectual, for although the lime would kill the acid in tar, it would not entirely prevent the acid passing from the wood through the paper or felt. It would perhaps be worth while for some shipowner to try the experiment, and sheath one side of a ship's bottom in the common way, and the other in the manner I recommend; the result would be ascertained in seven years, or perhaps in a shorter time. The lime would not injure either the wood or the copper.

I remain, your very obedient,

J. F. OLANDER.

43, *Fore-street, Limehouse, London,*
April 4, 1836.

BALLOONING.

Dr. Agme in a recent essay, which he read at the French Institute, endeavours to prove that it is possible to obtain such a hold on the upper atmosphere as to be able to direct a balloon with all the steadiness and certainty of a boat moving in the waters. This he proposes to accomplish by means of oars or levers to be attached to the car, and which are to be made of oiled skin, or cloth, capable of containing an adequate quantity of hydrogen gas, the specific gravity of which being lighter than the air would obtain a hold on the natural fluid, as they would meet with the same resistance as the balloon does itself—*Globe*.

OPTICAL MACHINE.

At the late Meeting of the British Association, Mr. Roberts exhibited a machine which renders objects visible while revolving 200,000 times a minute.

If a firebrand be whirled, in the dark, round a centre in a plane perpendicular to the eye of the spectator, it will present the appearance of a luminous circle. From this fact it has been inferred, that the impression on the retina made by the luminous body in its passage through every point of the circle, remains until the body has completed a revolution. How rapidly soever the firebrand may be made to revolve, the circle, and, therefore, every part of it, will be distinctly visible: hence a probability arises, that at the greatest attainable velocity, a perfect impression of the object in motion will still be produced on the optic nerve, provided that the time of viewing such object be limited to that which is required for passing through a small space—small, at least, with reference to the size of the revolving body—and also that no other object be presented on the field of vision before the former spectrum shall have vanished from the eye; unless in the case of the same objeet under similar circumstances. The former of these conditions is provided for in machine, No. 1, in which the eye-hole is made to travel through 180 feet between every two inspections of the moving object, and which object is made to assume a different position at each successive inspection. The latter condition is included in machine No. 2; the object is there presented to the eye in one position only.

APPLICATION OF THE COMPRESSIBILITY OF WATER TO PRACTICAL PURPOSES.*

By James D. Forbes, Esq, F. R. S. L. & E., &c.

Only two methods have been applied with much success to the *precise* determination of pressures communicated in all directions; the one, by observing the volume of air inclosed in a tube, as in the common manometer; the other, by the actual measurement of the height of an equi-ponderant column of fluid such as mercury. Each of these methods is subject to grave practical inconvenience: in the case of the manometer, from the immense disproportion of the division of the scale for great variations of pressure, and, in the other, from the extremely cumbrous and unmanageable apparatus which it requires when the pressures are considerable. Both these methods were resorted to by the Commission of the Institute of France, appointed to ascertain the relation of the temparature and pressure of steam, the pressure being ascertained by the volume of air in a manometer, previously graduated experimentally by comparison with the pressure of a column of mercury.

The idea of substituting a manometer constructed of water instead of air, occurred to me a considerable time ago, when applied to by a friend to suggest a form of guage for measuring the pressure of condensed gas intended to be used for a furnice. I had recently been making experiments with the very convenient compression apparatus of Oersted, in which the changes of volume of water

* Read to the Society of Arts on 22nd April, 1835.

and air are exhibited at once, under any pressure, that of the water being sensibly uniform for equal increments of pressure, whilst that of air rapidly diminishes.

It is the very trifling compressibility of water (or any other liquid) which gives the value to this application, and which seems to have been practically overlooked.

The reason is obvious. The changes of volume produced by a pressure of only one or two atmospheres, in the case of air, are quantities very large in proportion to the primitive volume, so that, in the consideration of an additional change, we are obliged to take into account not merely the effect upon the primitive volume, but upon the volume affected by the first unit of pressure. In other words, we are not at liberty to neglect quantities of the second order, which we may safely do in the case of any known liquid. In the case of water, for instance, the variation of volume for one atmosphere does not exceed $\frac{1}{20,000}$ of the whole; so that the variation of the variation is necessarily insignificant. All that we know of the constitution of liquids would lead us to infer, that such would be the case, and upon this circumstance depends the *linearity* of the expression, which connects the volume of a liquid such as water, and the pressure to which it is subjected.

Within ordinary practical limits, we may confidently anticipate the sensible proportionality of pressure and change of volume; and this is fully borne out by a comparison of the best experiments on the compressibility of water made within great and within narrow limits.

I did not hesitate, therefore, to recommend the trial of a manometer of water instead of air, for measuring the elasticity of gas up to 40 atmospheres of pressure.

The construction of such an instrument being almost like that of the common thermometer, is incomparably simpler than that of the other instruments above mentioned; and almost the only practical difficulty is common to all these, namely, the accurate determination of the temperature of the fluid employed.

It may be proper to remark, that Professor Oersted's instrument for indicating the compressibility of water, consists merely of a very sensible thermometer, constructed of water, and having the end of the tube left open. The tube being capillary, a short column of mercury rests on the surface of the water, indicating its volume at any moment; and the whole is immersed in water contained in a strong vessel, to which pressure is any how communicated, so that the thermometer-shaped vessel of glass being equally pressed within and without (the neck being open), is unaffected by pressure, and the true change is perceived in the volume of water which it contains.

The applications of this form of instrument are very numerous; we may take as examples,

1. The determination of the tension of gas or air in a compressed magazine, as I have just suggested.

2. The measure of elasticity of high-pressure steam.

3. The determination of the degree of compression under which bodies change their state, when such experiments can be performed in glass vessels, as in the case of the condensation of the gases into liquids, the pressures as stated by different authors varying extremely, and being confessedly imperfect approximations.

4. The ready determination, by inspection, of the pressure per square inch exerted by Bramah's press at any instant.

Nothing could be easier than to convert the instrument as above described into a self-registering one, by simply inserting an index of glass, which may be drawn back by the little mercurial column, just as in Six's thermometer. We should thus be enabled to determine the operation of causes by their nature concealed from direct view; as,

5. The force exerted by water in the act of freezing, in a manner much more direct and satisfactory than that of the Florentine Academicians, because it would not be necessary to cause the recipient to burst, the maximum expansive force being indicated by the register.

6. The force of fired gunpowder: and even of dead pressure and of percussion in a variety of cases.

7. The depth of the ocean by the measure of the pressing column, the instrument being attached to the sounding-lead. I have been informed that the ingenious Mr. Perkins proposed this application of the compressibility of water which naturally arose from his method of ascertaining the *fact* of compression by using the pressure of the ocean, though no notice of this is taken in his paper in the Philosophical Transactions. The Piezometer there described was like Oersted's instrument, intended for measuring *compressibility* not *pressure*.

In these cases, a Register Thermometer would need to accompany the self-registering instrument. Probably no considerable error is to be feared from abrupt changes of volume to which the water might be subjected, for the coincidence of the velocity of sound in water, theoretically deduced from its modulus of elasticity, and experimentally by M. Colladon, seem to prove that little or no heat is developed during its compression.

The accompanying thermometer would, of course, require to be itself protected from the disturbing influence of pressure.

The extensibility of the glass vessel containing the water under pressure, might be applied to give an independent confirmation of the first result; and elegant practical constructions might be pointed out by which these separate results might be obtained, and also the effect of temperature eliminated.*

* Jameson's Journal, No. 37.

HOUSE-FLY GUARD.

At the Entomological Society, on Monday, a paper was read by the secretary on excluding the house-fly. The mode adopted was a net made of different coloured meshes of about three-quarters of an inch square, and which, when placed against a window, was found quite effectual in excluding the visits of these troublesome insects from the outside of the room. The same experiment was tried with meshes made of the finest black thread, one inch and a quarter square, which proved to be equally effectual. The approach of wasps was also prevented by the above mode, very few finding their way within the boundary. This was accounted for by an optical illusion in the eyes of the insect, of the highly magnifying power of vision, and the small focal length.

MR. BRUNEL'S MODE OF CONSTRUCTING ARCHES WITHOUT CENTRING:—INSTITUTE OF BRITISH ARCHITECTS, 14TH MARCH.

The secretary read a paper explanatory of M. Brunel's mode of constructing brick arches out centring; and also explained various experiments of that gentleman, with regard to the insertion of iron hoops in constructions of brick-work in cement.* * * The principle, which was originally adopted, and its efficiency ascertained, in the formation of the shaft of the Thames with Tunnel, is founded upon the cohesive power of Roman cement, coupled with a system of ties, the most eligible substance for which, from a series of experiments performed by M. Brunel, appeared to be hoop iron. The piers having been constructed in the usual manner, it is proposed to pin or secure to them a mould for the purpose of determining the contour of the arch. A narrow rib may now be carried over, and keyed, using cement (with the occasional insertion of ties), which, by its adhesion to the brick being greater than the cohesion, enables the arch to be carried to any extent within the limits of the strength of the material. The several arches being in succession, once keyed, they will be in a state to receive the whole of the materials necessary to the completion of the bridge. The bridge of the Santissima Trinità at Florence was particularly adverted to, affording a magnificent example of rubble construction, and the durability of the material. The arches are composed of a mass of irregular stones embedded in mortar, having the consistence of a single stone, or of two stones abutting against each other at the crown.—*Ed. Arch. Mag.*

MACHINE FOR CUTTING SAUSAGE MEAT, AND STUFFING SAUSAGES, ABRAHAM AND JOHN KEAGY, PENNSYLVANIA.

The cutting is effected by means of a cylinder, around which are placed knives which we usually make of a triangular form, one of the sides being in contact with the cylinder. This revolves within a concave, or hollow cylinder, furnished with similar knives so placed as not to interfere with those on the cylinder. These knives are but placed somewhat obliquely, so as to stand in the direction of a spiral around the cylinders. The revolving cylinder has its axis placed horizontally in a box, the sides and ends of which are enclosed excepting where the meat is admitted and discharged. A gudgeon projects through the box at one end to receive a crank of wheel to turn the cylinder.

The opening for feeding is on the upper side, and at one end of this box; and this opening is surmounted by a vertical trunk, which may be in the form of a parallelogram, of the width of the lower box, and about half its depth, more or less. A piston, or follower, is adapted to this feeding trunk, or hopper, from the middle of which a rod rises, operating as a piston rod, being acted upon by a lever, worked like a pump-handle. The piston rod passes through the lever, and has a rack, or notches, upon it, which engage with the lever in its descent, but allow it to rise without raising the piston, so that the meat put into the feeding-trunk is forced down by each successive stroke. To facilitate the passage of the meat into the horizontal, from the vertical trunk, I form a spiral excavation in the hollow cylinder, immediately under the vertical trunk; which operates as an inclined plane in producing the desired effect. The cut meat, when it arrives at the extreme end of the cutting cylinder, passes out through an opening in the bottom of the box. When the feeding-trunk is to be replenished, the lever may be turned back on its joint, and the piston removed, leaving the opening perfectly free.

When the cutting has been completed, the vertical trunk, with its piston, is used for the purpose of stuffing. To effect this, a shutter, or slider, is slipped into its place where it forms a bottom to the vertical, and cuts off its communication with the horizontal trunk, and a tin, or other tube, of proper size, is fitted into an opening prepared for it on one side of the trunk, at its lower end; upon this tube the entrail to be stuffed is gathered in the usual way.

To allow the escape of air, this latter tube has a small tube, or opening, soldered on its outside, from end to end. This opening may be semicircular, so as make but a slight projection on the stuffing-tube. The effect of this will be obvious.

We have not thought it requisite to give the dimensions of the respective parts, as they will vary according to convenience, and will depend upon the power to be applied, and the quantity to be cut. One thing, however, is essential, namely, that the length and size of the cylinders, and the number of knives, be proportioned to the quantity to be cut; but this can be regulated also by the pressure made upon the piston.

THE SPIRIT OF THE INDIAN PRESS,

OR

MONTHLY REGISTER OF USEFUL INVENTIONS,

AND

IMPROVEMENTS, DISCOVERIES,

AND NEW FACTS IN EVERY DEPARTMENT OF SCIENCE.

TRANSPLANTING LARGE TREES.

The operation of transplanting a large tree is described in the *Madras Herald* as having been recently carried into effect at Mr. Chamier's garden in Buffalo-Square, Madras. We learn that the machine which is used in transplanting the tree is exceedingly simple. The plan consists in cutting through all the horizontal roots of the tree which is to be removed, at the distance of about three and half feet from the stem, making a trench about thirty inches wide around the tree, and putting in loose surface mould and a little comport to encourage the growth of young fibres. The shortest time allowed for this operation in Scotland, where it was first practised, is two years—and in some cases trees are allowed to stand four or more years before they are removed. In this country it appears that a tree may be transplanted with perfect safety in four months after the roots are cut through—at the end of which time, as was found in the present instance, an immense quantity of young fibres, some perhaps two feet long, are thrown out from each divided root.

When the tree is about to be transported to its new site, the earth is carefully cleared out from the young fibres, the tap-roots are divided, and the tree, having been previously fastened to the transplanting machine, is taken without difficulty wherever it may be required. Trees may be removed in this manner to a considerable distance, from Madras to Guindy for instance, without losing a single leaf.

All the different species of *banian*, of which there are four or five very common in Madras, are the easiest and surest to move, with complete success. The best season for transplanting them is during the hottest weather, as too much rain is apt to destroy the young roots.

The *corially* (so pronounced), a beautiful, clean tree, which grows to a large size and very rapidly, may also be removed without difficulty.

The *peepul* (or *Arsii Marum)* is the next on the list. It can be transplanted to any size, and scarcely ever fails, provided it is done at the right season. This tree requires even less care than the *banian* and ought not to be very highly manured, as it is apt to shoot up too quickly, resembling the poplar.

The *tamarind* is among those trees which are not easily moved; indeed it was thought impossible to transplant it successfully, within a few months, when Mr. Elliot completely succeeded in removing a tamarind tree about 20 or 25 feet high. The tree was prepared nearly a year ago, and transplanted in June 1st. It did not lose a leaf, and is now thriving and filling out daily.

The *neem* (or Margosa) is a difficult tree to manage, extremely sensitive at its roots—and, if the tap-root is touched ever so little, is hopeless. Several of these trees have been moved, however, and are now large and healthy after the lapse of two years. The expence attending the transportation of these trees is great, in consequence of the immense quantity of soil which is usually attached to them.

In addition to these very large trees, there are about a dozen chiefly flowering trees, which are good *subjects* for transplantation. We learn, that the *Vadenarrain*, a beautiful tree like the *Gloriosa Superba*—the *Cork—the Wood apple tree* and the *caoutchouc* or India Rubber tree,

are all easily transplanted: and that handsome specimens of them are now flourishing at Guindy, which have been taken thither from Madras.

PEARL FISHERY.

From a paper published by Lieut. Whitelock of the Indian Navy, in the Transactions of the Geographical Society of Bombay, we learn that the pearl fishery in the neighbourhood of the Persian Gulf gives employment to no less than 30,000 men, and produces 40 lacs of rupees' worth of pearl annually.

SURVEY OF THE MALDIVES.

A paper on the Maldives is also published. This curious group of islands is on the direct tract of ships bound from Calcutta to Bombay. The desire of aiding the project of steam navigation; induced to their careful survey; they were however found exceedingly unhealthy, which circumstance has been the great obstacle to their foreign intercourse and internal improvement.

THE INDUS RIVER.

A valuable paper is also given on the Indus by Lieut. Wood, who has been employed by Government in surveying that river. This paper contains a narrative of the Lieutenant's passage in the little Steamer Indus from Hyderabad to the Sea. The result of his experience was rather unfavourable to the navigation of the river, in the Delta.

POPULATION AND EXTENT OF CACHAR AND ARRACAN.

We learn from a report on the eastern frontier by Capt. Pemberton that the new population now rising in these countries, especially in Cachar and Arracan, is quite distinct from the original inhabitants, and consists chiefly of settlers from the adjoining parts of Bengal. It is still extremely inadequate to the cultivation of the soil. According to Captain Pemberton, the whole valley including Upper, Central, and Lower Assam, has an area of 18,900 square miles, and a population of 602,500 souls, or nearly 32 to the square mile; whereas from the richness of its soil it will support a population ten times as numerous as that which now occupies it. In 1833, Captain Fisher estimated the quantity of arable, but unoccupied land in Cachar at 1,800,000 biggas. The entire area of Arracan is calculated by Captain Pemberton to be about 16,520 square miles; and the statistical returns for 1831 gave a population of 73,928, or $10\frac{1}{2}$ to the square mile. Hence it is evident that in these three provinces there is the widest scope for colonization. There is land in abundance unoccupied, which is at the perfect disposal of Government, and may therefore be allotted to new settlers on whatever terms may be thought expedient. There are no existing rights to be interfered with, and no population to be thrust out of their native acres.

LINES OF COMMUNICATION BETWEEN THE BRITISH POSSESSIONS AND THE BURMAN EMPIRE.

We also learn from the same report which we have abstracted from the Friend of India that an army, proceeding from Calcutta to Ava, would reach that city, by the Assam route, in 170 days, by Muneepore, in 107; by Rangoon, in 82; and by the Aeng Pass in Arracan, in 39 days. From the comparison of routes, it is manifest, that if ever the Burmese are again foolish enough to engage in hostilities with the English, and it be considered expedient to renew our invasion of their territory, the way of the British army must lie through Arracan.

With the exception of Muneepore and Upper Assam, the whole of the inhabited country on the Eastern Frontier is now under British rule; and the excepted portions are under British protection and influence. In the first years of our way over these new territories, many errors were committed in the schemes of taxation and judicial administration which were adopted. But as, we doubt not, an honest intention existed on

the part of Government to do what was right and just, a gradual improvement has been apparent every where; and the effect of this upon the increase of the population has been most remarkable and satisfactory.

POPULATION OF NAGPORE.

The following is a copy from the report of Mr. Jenkins in the Nagpore territory.

Statistical Table of the Population of Nagpore.

According to the census of 1820-21, the population of the several districts and the city stood thus:

Deogurh below the Ghauts	4,84,657
Wyne Gunga districts	6,60,040
Chutteesgurh	5,71,915
Chanda	2,79,555
Deogurh above the Ghauts	1,07,503
City of Nagpore	1,11,231
Total	22,14,901

Assuming that the rate of increase in Chutteesgurh (where no subsequent census was taken) was the same as in other parts of the country, the population, according to the census of 1825, is as follows:—

Deogurh below the Ghauts	5,72,792 in 1890	[villages-towns &
Wyne Gunga districts...	6,90,770 in 2111	ditto.
Chutteesgurh	6,39,603 in 4434	ditto.
Chanda	3,06 996 in 1223	ditto.
Deogurh above the Ghauts	1,45,363 in 1241	ditto.
City of Nagpore and Subrs.	1,15,228	
Total	24,70,752	

being an increase of 2,55,848 in the course of five years.

Tables of births and deaths have been kept in the Wyne Gunga district for the last four, and in Deogurh bellow the Ghauts, for the last two years. They give the following results:—

Wyne Gunga district in 1831

Total population, 6,60,040

Births 25,436..Deaths 14,015,

being as one hundred to fifty-five, nearly.

The births are one in twenty six, nearly, and the deaths one in forty-seven, nearly.

The excess of births above the deaths, is 11,421, and the proportion of excess of births above the deaths, to the whole of the living, nearly one to fifty-eight, so that, at this rate, the population would double in about forty years.

In 1832.

Total population, 6,71,117.

Births 27,692 ... Deaths 15,564.

being as one hundred to fifty-six nearly. The births are one in twenty-four, nearly—the deaths one in forty-three, nearly.

The excess of births above the deaths, is 12,128, and the portion of excess of births above the deaths, to the whole of the living, nearly one to fifty-five; consequently, the period of doubling is about thirty-eight years and a half.

In 1833.

Total population of the Wyne Gunga and Deogurh, districts, 12,63,562.

The births 47,896 .....The deaths 23,103.

The births being to the deaths, as one hundred to fifty and a half, nearly.

The births are about one in twenty-nine and a half; the deaths are one in fifty-three and a half.

The excess of births above the deaths, is 18,873; the proportion of the excess to the whole of the living, being nearly one to sixty-five, the population would double in forty-five years.

In 1834.

Total population of the Wyne Gunga, and Deogurh districts, 12,63,562.

Births, 47,896... Deaths 29,946.

The births to the deaths are one hundred to sixty-two and a half, nearly.

The births, one in twenty-six. The deaths, one in forty-two. Excess of births above the deaths, 17,950; the proportion of this excess to the whole of the living being, as one to seventy; at this rate, the population would double in about forty eight years.

GEOLOGICAL CHARACTER OF THE MOUNTAIN RIDGE BETWEEN SYLHET AND ASSAM FROM CHIRRAPOONJEE TO GOWHATTEE.

Within this range there appear to us to be four distinct formations, which claim particular attention from the geologist. The first is the surface of the present epoch, arising from the silt of the numerous and magnificent rivers, which from the East, North, and West, pour their waters through the plains of Bengal into the ocean, laden with the annual spoils of our great mountain ranges. In traversing the various streams of the Brumhapootra, the Teesta, and the Ganges, endless opportunities are afforded us of marking the successive changes through which the light, gray, and perfectly incoherent, micaceous sand, just deposited from the last overflowings of the rivers, passes into infinite varieties of soil, by gradual decomposition of its own component elements, by incorporation with the vegetable matter which even in one season begins to grow and rot amongst it, and by mixture with the older and richer deposits, which the rivers in their capricious changes are continually breaking up and distributing afresh. In such observations, with Mr. Lyell's chapters on the formation of deltas in our hand, we found endless entertainment in the first months of the present year: and often we wished that this distinguished Geologist had an opportunity of exploring our magnificent river courses, and adding the data they furnish to his accumulated treasures.

The next formation, if we may call it so, which demands attention, is the strong red clay which is found on all sides, at the extreme verge of the range within which the present mutations of the rivers are confined. We have remarked it on the west coming in to the very banks of the Bhagurnttee not far from Moorshedabad; on the north in the districts of Dinagepore and Rajshaye; at Sobar, a few miles north west of Dacca, where it forms an abrupt and striking bank to the river, and at Dacca itself a few feet under the surface of loose soil similar to that of the middle parts of Bengal; and lastly for several miles on the south bank of the Brumhapootra, just above Goalpara, where, in contrast with the ordinary banks of the river, it looks more like a precipice of rock than mere clay. This clay has long appeared to us like the remnants of an ancient continuous surface through which the rivers have cut their channels for ages, so as nearly to have effaced it altogether. In the proper delta of the Ganges, or the great plain enclosed between the Bhagurnttee and the main stream of the Ganges to its conjunction with the Megna, we have not seen a fragment of this clay, but are not confident that it may not be found in the Fureedpore district where we once thought we perceived the country to have an undulating surface differing materially from the rest of the delta.

Another most important formation includes the carboniferous systems of Burdwan, Sylhet, and Assam. These we may conceive to be contemporaneous deposits formed in a marine bed including the whole of Bengal, Assam, and the entire valley of the Soorma. On the western side in Burdwan and Beerbhoom they appear to have been lifted but slightly from their original situation; for the coal

measures we believe extend away indefinitely below the plain surface of the country. But on the eastern side, in Sylhet and Assam, we are presented with a very different appearance. There the coal strata are thrown up as by one convulsion to a height of more than 4000 feet above the neighbouring plain; from which the whole system to which they belong rises at once, like a steep bank of a river guttered by immense falls of rain. It is a most interesting inquiry to make: Does the plain of the Soorma cover over a counterpart, yet in their original place, of the deposits which we observe heaved up to the skies at Chirrapoonjee? or, when these last were thus heaved up, did the fearful convulsion by which that was accomplished break into fragments the remaining parts of the ruptured series, and sweep them away to fill up by their debris some ocean deeps of the present Bay of Bengal? In reference to this inquiry, satisfaction might best be obtained by boring at Sylhet and Chattuck: but to whom are we to look for such experiments?

Perhaps the same object might be gained by a careful observation of the last formation we have to notice, consisting of the primitive rocks; by which it is plain that the secondary formation just mentioned has been tossed out of its original place. These primitive rocks may be studied with great advantage on the northern side of the Khassia mountains, where they are of great extent, and much exposed in numerous immensely deep rents, which are now river courses; and, also all down the valley of the Brumbapoottra, which is studded with beautiful groups of hills entirely composed of them. The granite, gneiss, and schist of this formation deserve the closest examination; and, from the little we were able to see of them, we should think they would furnish numerous appearances not less striking than those of the celebrated rocks of Glentilt. Just under the cutcherey at Goalpara we noticed a most singular confluence of different rocks, which must have run in a semi-liquid state into one mass; and similar phenomena we caught glimpses of elsewhere. But the most interesting part of their examination would be their relation to the secondary strata. It appears certain that down the plain of the Brumhapootra, far into Bengal itself, the present soil lies immediately upon these rocks; no secondary strata intervene between it and them. Can it be decided that no secondary strata were ever deposited in the same place, before they came up to the surface; or that secondary strata were there and have been swept away? And can it be ascertained where in the plains of Bengal, the secondary strata of Burdwan are broken off by the primitive system traced down from the north and east?*

TEA FORESTS IN ASSAM.

Mr. Bruce of Sudiya has discovered no less than *ten* new localities, in which the plant is growing in abundance and vigour. All the ten localities now discovered are in one vicinity, which, on looking at any tolerable map of the eastern portion of Assam, our readers may easily recognize by the help of the following description. Sudiya, it will be seen, lies on the north bank of the Brumhapoottra, at the junction of a small river called the Koondil Panee. The country to the south is watered by two rivers, the Dibooroo and the Booree Dihing, which both run from eastward to westward, and join the Brumhapootra at different points below Sudiya. If a line be carried nearly south, with a slight inclination towards the east, from Sudiya, until it cuts the Booree Dihing, it will fall upon the village of Ningrew, on the north bank of that river; and all the new localities of the tea plants are scattered in almost every direction around this village at various distances, from half a day's to a whole day's journey. Seven of the localities lie between the Booree Dihing and the Dibooroo; and the remaining three are to the south of the former river, and to the southeast of Ningrew, upon small tributary streams of the Booree Dihing. Immediately to the west of Ningrew, and on the north side of the river, is a low range of hills, from a hundred to a hundred and fifty feet high, on the tops of which an inferior tea is said to grow wild: but because of its inferiority the Singphos pay no attention to it. The plants of this sort do not grow above ten or twelve feet high; the largest leaves are not more than an inch and a half in length, and they are much more indented than those of the other sorts. Another kind of tea also grows about in the jungles in the neighbourhood, and on the Naga hills about a day's journey from Ningrew, to the south of the Booree Dihing, which is equally disregarded by the Singphos, and is known as the *bitter* tea. It is distinguished by the brown colour of the central thick fibre, and also of the edges of the leaves. This sort, it is said, will not grow in the same neighbourhood with the finer kinds: at least, they are never seen together.

Thus, it appears, we have three varieties of the tea plant. That which the Singphos make use of is not at all bitter, and differs widely from the sort produced in the Hookoom country in the Burman territories. Indeed from a trial of some of this tea, prepared in a particular manner, Mr Bruce is firmly persuaded that it will prove to be *Green*. To raise plants of this tea, the Singphos sometimes sow its seed: but they prefer one mode or another of planting shoots. Some cut off twigs about a foot and a half long, just as the young leaves begin to shew themselves, and lay them in the earth, in an angle of about 45°, with the top of the twig appearing at the surface. Others take a branch as thick as a man's arm; and, having cut deep notches in it, about one-third through it, and three feet apart, lay it in the ground, and cover it all over excepting where the notches are: at the notches the new shoots spring up.*

CANAL BETWEEN RAJMAHL AND CULNA;—MINING;—RAIL ROADS.

We are happy to perceive that the construction of a canal from Rajmahl to Culna, with the view of keeping open the communication of the Western with the Lower Provinces throughout the year, still engages the attention of Government. This is an object of the highest national importance, and the completion of it will form an era in the history of India. We have heard the expense of the canal estimated at between forty and fifty lakhs of Rupees: but, great as this sum may appear, it is not to be put in comparison with the advantages which such an undertaking would confer on the trade of the country. But while the question of so large an expenditure is on the tapis, it would not be imprudent to enquire, whether the same sum, or perhaps even less, might not be sufficient for laying down a noble rail road between Rajmahl and Calcutta. We are not acquainted with the local obstacles which exist to the accomplishment of such a scheme, but they cannot be greater than those which European enterprize is accustomed to overcome in England. The division of the country, through which it would pass, is more free than any other section of Bengal.†

INDUS STEAM NAVIGATION COMPANY; AND PROPOSAL TO UNITE THE SUTLEGE WITH THE JUMNA.

Our readers are already aware that it has been " proposed to have two iron tug steam

* Friend of India.

* Friend of India.

† Friend of India.

vessels, and four iron lighters, to draw when loaded, four feet water; one tug boat would tow two lighters six miles an hour against the current of the Indus, or 600 tons of goods to Attock or Loodianna, in twenty-one days, if steaming twelve hours per day, and fourteen days of steaming eighteen hours, and ten and a half days if she steamed day and night each vessel at the consumption of 120 tons of coals per trip. Supposing she made eight trips per annum, she would convey up 4800 tons, with an expenditure of 1000 tons of coals. Two tugs would, therefore, convey annually 9600 tons into the centre of Asia, with an expenditure of 2000 tons of coals. A mean rate of freight may be taken at £3 per ton, which would give an annual receipt of £28,800; exclusive of any downward freight or passage money up and down. It is evident all Europeans and the respectable natives of the upper provinces will prefer this route to the tedious and expensive water conveyance by the Ganges or land carriage."

In case of emergency these vessels would be available to the Indian Government for transporting 2000 troops in one trip from the entrance of the river to Loodianna.

In addition to the foregoing, we find, in that ably conducted Journal the Mofussal Akbar, a paper characteristic of its lamented but talented and enterprizing author Mr. Henderson, shewing the feasibility of cutting a canal to connect the rivers Sutlege and Jumna for purposes of navigation. He had previously assumed that the best line in all probability would be a direct cut across from the Sutlege at Ferosepoor, the point where the Beegas joins it, to Koonjpoora on the Jumna; but as he afterwards found that the Sutlege above Ferosepore has a north-easterly direction and might probably alter its course at Tehara, thereby obliterating a portion of the canal, he proposed to examine the line between the last mentioned station Tehara, and the nearest point on the Jumna, the distance between the two rivers being there about one hundred and thirty miles.

"The country between Tehara and Jumna appears to the eye to be perfectly flat. Insulated sand hills indeed are here and there situated over the country, being generally selected as the sites of villages, but do not interfere with the general level. The Sutlege is one furlong broad where he examined it at Tehara, its average depth may be reckoned at five feet, and where the banks are under three feet high, the utmost depth may be estimated at seven or eight feet. Boats drawing three feet of water may come up to Ferosepore, but after passing that station, they would probably require to draw even less than two feet. The Jumna is navigable during the whole year for boats of 500 maunds as far as Borassee Ghat, still its waters have been diminished so much by canals intended for irrigation, that it would not appear to him advisable to take the water for the proposed canal from that river."

Mr. Henderson adds "that the Sutlege seemed to flow about 19 feet above the line of springs; that the different nuddees were from 12 to 20 feet above it, the lower ones containing the greatest quantity of water, and that the Jumna, which is about 14 feet under the Delhi Canal, is 15 feet above the line of springs."

"It may be observed by examining the map of the country situated between the Jumna and Sutlege, that the rivers arising from the intermediate hills, have a tendency to courses which may be represented by radii of a circle, having its centre in the point where the courses of the two rivers, after issuing from the mountains, would intersect each other." With reference to the expense required for the construction, Mr. Henderson remarks "that the cost of the trunk road in the upper provinces may be estimated at 300 rupees per mile, allowing 50 cubic feet of earth raised, as the average work per day of the convict or labourer. Now supposing the canal to be 27 to 30 feet wide, the above sum would be required to be many times multiplied in order to construct the proposed canal. 300 rupees multiplied by 20; that is 6000 rupees per mile, or 8 lacs of rupees for one hundred and seventy

miles; the proportion of cost would bear nothing in comparison with the advantage which might be derived from so important an undertaking.

Mr. Henderson recommends that the Sikh states through which the canal would have to pass, and whose revenues amount to above 55 lacs of rupees, should be called on to defray the expense of its construction; being guaranteed by Government in a moderate rent, sufficient to cover the interest of the prime cost on an average estimate of the traffic after the canal had been several years constructed.

We think this latter proposition is not likely to be carried into effect. We suggest to our friends at Agra, a joint stock company, as more feasible.

The advantages to be derived from the construction of the canal are innumerable. We need only state that this would soon become the route to and from Europe.

THE PRACTICABILITY AND PROBABLE EFFECT OF A BREAKWATER AT MADRAS.

We perceive some very important documents in the Madras Herald of the 17th September on the above subject. A letter from G. Rennie, Esq. to Capt. Grindley dated 3rd December, 1835, gives the following description of breakwaters which have been constructed from the earliest to the present time.

The ports of Alexandria, Tyre, and Carthage, were partly protected by moles, or breakwaters of loose stones, and in the time of the Greeks similar works were constructed at Ephesus, at the celebrated port of Pyrœus near Athens, at Egina, Mytelene, Lemnos, Cyssus, Milo, Naxos, Eubœa, &c.; and in the time of the Romans, the most famous artificial ports were Portus Lumœ of Hercules (now Leghorn), of Brundisi, Tarentum, of Misena, Puzzuoli, Nisela, Ravenna, Ancona, Ostia, &c.; of which the latter presented the example of an insulated breakwater in front of the harbour. In later times the celebrated insulated breakwater of Civita, Vecchia, of Trani, and Barletta in Italy: and in more modern times the moles of Genoa, Messina, Rhodes, Cette, Nice, Antibes, Toulon, Valentia, Barcelona, Carthagena, Cadiz, Corunna, Ferrol, Rochefort, the Isle of Rhe, St. Jean de Leon, and lastly the famous insulated breakwaters of Cherbourg, Plymouth, and Delawarre—Examples are not wanting therefore of moles, acted upon by the waves, either in connected, or in insulated masses. The methods of construction adopted by the ancients, were either by throwing large stones into the sea, until they had formed masses of sufficient magnitude to resist the action of the waves, or by sinking masses of stones and cement held together by frames as described by Virtuvius, or by jetties of piles driven into the sea as practised at Eubœa and elsewhere. The moderns have adopted the same methods according to circumstances, and there seems no reason to deviate from the ancient practice, although several plans for the formation of breakwaters have been proposed and practised by the moderns, as the masses of brick and cement sunk at Sheerness, by the late General Bentham; and which entirely failed, and the more absurd propositions of floating chests of wood, and cast iron. The destruction of the cones at Cherbourg and subsequently of the barracks on that Breakwater, have taught the French several dearly-bought lessons. The most approved method of forming breakwater has been to throw large stones weighing from 5 to 10 tons in the line of direction of the proposed breakwater, and allow them to assume their natural slope, which they will do below the action of the waves, and the waves will perform the rest. But in order that these slopes may be formed it becomes necessary to give such a base as shall allow for the natural slopes both below and above water, and this, experience has shewn to be the case both in Cherbourg and Plymouth Breakwaters. The original form of the Cherbourg Breakwater was a prismatic figure, having 2 natural slopes of 45 degrees and one sea slope of 8 degrees: experience has, however, proved the total inadequacy of the Cherbourg Breakwater as originally constructed in 1781 after the failure of the cones, inasmuch as that its dimensions were too feeble to resist the impulse of the waves at low water, and that it afforded no protection to the roadsteads between high and low water—the magnitude of the works has been tripled and in some places quadrupled since that period; and when completed it expected to have its summit raised 10 feet above high water. To have a natural slope of about 45° on its interior side between high and low water marks a sea slope of $5\frac{1}{2}$ to one and from low water mark to the bottom a natural slope of 45°

The Plymouth Breakwater was originally proposed to be constructed upon the triangular system, with its interior slope inclined to one angle of 45° and its exterior or sea slope at 18° or $3\frac{1}{2}$ to one. Subsequent consideration, however, led Mr. Rennie to adopt an entirely new form for its section. The average depth of the Breakwater at Plymouth below low water of an 18 feet tide is forty feet, but in some places the depth is 43 feet and in others only 20 feet: now the breadth of the Breakwater in the part where it is 20 feet in depth at low water (and which is the depth of the water at Madras) is 350 feet at the base, including the slopes—as it is now completed—the top of that part of the Breakwater having been swept or flattened down towards the land side by the great storm of 1829. The base was then only 250 feet, thus pointing out the necessity or further augmentation of base and a change in the slopes. The actual section of the Breakwater as now completed is shewn by the annexed diagram.

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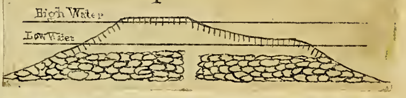
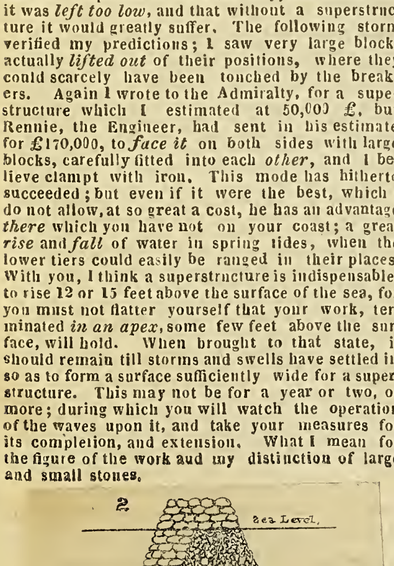


Mr. Rennie states that the above form has been found to answer most effectually and to remain undisturbed during the greatest storms. Another letter addressed to Capt. Cotton is of great importance, for it emanates from Major De Havilland, whose

opinions are grounded upon local knowledge and long experience of public works in India. This officer observes:

"A very small stone, laid on the mud or sand, at a depth of 70 feet water, will remain unmoved for ages. I should say that one granite, *rough quarried* of a *cent weight* would abide there, in the Madras road: as the work rises, it becomes more exposed to the action of the element; and, instead of a flat yielding surface to stand and impress upon, it would have an inclined plane of hard substances like itself—but the weight of a stone increases in a *triplicate* ratio; while its horizontal section does so only *duplicately;* the effect of the water may therefore be counteracted by increasing the size of the blocks. I again repeat what I have held, *officially* and *privately*, that the base of the work should be left to *Nature*, and they will place themselves in their right situation; and, above all, observe to use the smaller stones *first*, reserving the larger blocks for the *last*; you may safely employ stones under a *ton* weight down to half, or even a *third* of a ton, until your work is at man's height from below the surface, or rather until you find that your *apex* is constantly thrown over, and blunted as it were:—*then* you should begin your heavier stones, but cast them on the *inner* side: it would be idle to press your large blocks on the outer side. The *inner* well secured, the sea will never move the *outer*, after it has acquired the proper *Talus*. At this stage you will find the greatest difficulty, your work will often be disturbed; not so much by the striking of the surf, as by the *lifting* of the waves; the undulation of the water has that effect; the waves subside with accelerating velocity, and rise with the velocity so accelerated, lifting or tending to lift the bodies it acts upon: hence it is that a work in the course of execution, suffers more when it reaches the trough of the waves, than when it is just at the surface. The first storm that occurred after my return from India, did some damage to the Plymouth Breakwater. I went to see it. I reported to the Admiralty, and stated that it was *left too low*, and that without a superstructure it would greatly suffer. The following storm verified my predictions; I saw very large blocks actually *lifted out* of their positions, where they could scarcely have been touched by the breakers. Again I wrote to the Admiralty, for a superstructure which I estimated at 50,000 £, but Rennie, the Engineer, had sent in his estimate for £170,000, to *face it* on both sides with large blocks, carefully fitted into each *other*, and I believe clampt with iron. This mode has hitherto succeeded; but even if it were the best, which I do not allow, at so great a cost, he has an advantage *there* which you have not on your coast; a great *rise* and *fall* of water in spring tides, when the lower tiers could easily be ranged in their places. With you, I think a superstructure is indispensable, to rise 12 or 15 feet above the surface of the sea, for you must not flatter yourself that your work, terminated *in an apex*, some few feet above the surface, will hold. When brought to that state, it should remain till storms and swells have settled it, so as to form a surface sufficiently wide for a superstructure. This may not be for a year or two, or more; during which you will watch the operation of the waves upon it, and take your measures for its completion, and extension. What I mean for the figure of the work and my distinction of large and small stones.

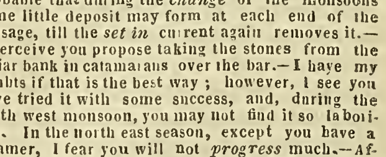


There will be great saving of materials by this mode of erection, for I am certain the idea of the work assuming a wide base at a great depth of water is quite erroneous; and whatever more is given to it than the weight and shape of the stones would effect, is *waste* to all intents and purposes. Your superstructure should be 12 or 15 feet thick; and probably nearly as high.

There is a great advantage in this way of proceeding; that, however, the work may suffer from time to time, it can only become more consistent and secure; it must, in the end, bring the work, if persevered in, to its intended use and effect. You should make some allowance for subsequent operations, when you determine on your distance from the shore; all that is *thrown* over, will fall *within* the work. I think 20 feet a good depth for the object now in view, measured from the *clayey* bottom; whatever there may be of sand above it will move away when the work is completed. 200 yards in length is little enough—but the *horns* of your work will give it length. That dimension however is of the least importance, as it may subsequently be added to, when its operation has been observed; and thence you may best know at which end to make the addition. The angle at the shoulder of your horns, which will act as the *starlings* of a bridge, should form an angle of about 150 deg. with the line of the breakwater; when the body of the work is raised, the lengthening of the horns will accelerate the current, and keep clear of sand the space in shore. I observe you expect an accumulation to form opposite the centre of the breakwater, in a curved line against the bulwark: upon this point I differ from you; I think, on the contrary, that your horns will make the water deepest *there*, and accumulate the sand on the opposite side against the Breakwater. When the work is completed, it will be convenient in every respect to erect a quay with cranes, on the line drawn on your plan, where you expect the accumulation; and ultimately a similar quay where I expect it to be formed; whereby the current will be greatly accelerated. The horns may, by degrees, be lengthened, if required, to clear the passage of sand; but it is probable that during the *change* of the monsoons some little deposit may form at each end of the passage, till the *set in* current again removes it.—I perceive you propose taking the stones from the Adiar bank in catamarans over the bar.—I have my doubts if that is the best way; however, I see you have tried it with some success, and, during the south west monsoon, you may not find it so laborious. In the north east season, except you have a steamer, I fear you will not *progress* much.—After the breakwater is raised so as to *affect* the surf, you may perhaps do better, by bringing the stones from the Mount down to the Custom House; this would be for the *large stones* especially.

Should this undertaking answer your expectations, I should in your place keep in mind the construction of a railway, from the south side of the Adiar.—It has long been in my contemplation.—Nay, I believe, in some of my reports, I hinted at one, or a *carrying Nullah* from the *Seven Pagodas* at Mahabalipooram, to bring the fine granite in that neighbourhood to Madras.

If your horns are extensive, the intermediate space *outside* will fill up to a certain degree with sand, during what I may call the *aquastice* season, or during a succession of mild monsoons;—and in time a counter breakwater may be made beyond this accumulation, so as to form a solid body in this shape."



THE INDIA REVIEW

OF WORKS ON SCIENCE,

AND

JOURNAL OF FOREIGN SCIENCE AND THE ARTS,

EMBRACING

MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS, &c.

REVIEW.

Notes on the Geology of the Country between Madras and the Neilgherry Hills, viâ Bangalore, and viâ Salem. By P. M. Benza, Esquire, M. D. *of the Madras Establishment.*

Continued from page, 260.

We now proceed to join Dr. Benza on his journey to the Neilgherry hills; and, strange as it may appear to those unaccustomed to ideal travelling, we, sitting within the ramparts of Fort William, can still imagine ourselves in the company of our talented and agreeable author. We can behold with him the lovely scenes he has witnessed, and with his avidity share the delights of his discoveries. He travels to a bungalow near Allampaucum on the road from Poonamalee. Monotonous plains alone are seen, and, with the exception of a few straggling pieces of a chloritic slate derived from some of the hills at a distance, there is nothing of interest to the geologist at Allampaucum. Near the bungalow, however, to which we have alluded, there are protruding rocks composed of foliated felspar of a pale flesh colour, in some places decomposing; it occasionally imbeds angular pieces of white transparent quartz and, *vice versâ*, the quartz imbeds the felspar. Quartz pebbles which originate in the disintegration of the huge veins of quartz seen protruding through the soil, bestrew its surface. The surface of some of the pebbles are of a red colour, extending for some lines into their substance, which circumstance Dr. Benza attributes to the effect of the infiltration of oxide of iron after the disintegration of the veins. We now arrive at Goriattum, approaching which, the country becomes hilly, and majestic arboreous vegetation is observed in the ravines and on the declivities of the hills. The projecting rocks are of granite, both common and sienitic. We proceed west; the country is interspersed with hills and valleys. All the hills are granitic, the rock being traversed by thick veins of quartz. In some places there are numerous pieces of quartz magnetic iron ore. Numerous beds of chloritic rock are seen at Sautgur sometimes porphyritic; in other masses the minerals are distributed either in strata or uniformly through the substance of the rock. Below the hills the rock is of sienitic granite, intersected by thick veins of quartz.

"This sienitic granite, besides the hornblende intermixed with the other minerals, has nests of it formed of the pure foliated mineral, or in a granular state, with some pieces of compact felspar, so as to resemble hornblende porphyry.

All the plain below these hills is bestrewed with numerous pieces of quartz and of foliated felspar, this last mineral being regularly crystallized, and its surface shining when seen at an angle with the light.

On both sides of the road are seen, nearly level with the soil, the convex surfaces of large masses of a porphyritic rock, composed of regular crystals of red felspar, hornblende, and a lively pistachio coloured substance—(chlorite?)

The approach to Laulpet is represented as picturesque, surrounded by hills, and the valley highly cultivated with gardens and fruit trees. There is a magnificent mosque, and

near the river are majestic tamarind trees, tending to add to the beauty of the scenery. On both sides the river the country is alluvial and sandy, and for two or three miles interspersed with hills and knolls: rounded blocks, like logging stones, are observed on their summits and sides. Dr. Benza discovered on a ridge, divided by a torrent from a high hill specimens of sienitic granite and a few plates of mica in addition to the other three minerals. Among them he found one resembling an analogous rock he found at Chinnapatam like red porphyry, but having nothing porphyritic in its structure, being composed of red foliated felspar—fracture rather shining—honey-combed with numerous small cavities, filled with yellow substance, some being a micaceous, brilliant, metallic powder, strongly magnetic. Our author advances to Baitmungalum where he feasted on grapes, peaches, and apples, of an exquisite flavour, the produce of Bangalore and Palamanar: the climate is represented as mild. Leaving behind the eastern ghats, our author found rocks of gneiss, the contorted strata of which are seen almost in every one of the blocks. A mile to the west near Golcondapatam blocks of granite are scattered over the plains. In the dry bed of a river Dr. Benza discovered a thick basaltic dyke which stretched across the whole breadth of the river, its outgoings being split into rhombs or parallelopipeds, the dyke, appearing to burst through granite. The blocks of granite scattered over the plain resembled the erratic boulders found in the plains of Sweden, Russia, and Northern Germany, derived from the Scandinavian mountains. The granite exfoliates in concentric laminæ of different thickness. In the sienitic granite nests of greenstone porphyry are imbedded, as is the case in almost all the localities in India where this rock is found. Our author proceeds west towards Shamarpilly, near the road to which is seen, a little oblong knoll, or rather undulation of ground on the tops of which rise many blocks of hornblende rock containing very little felspar: structure semi-foliated, fracture glimmering, quartz veins intersect it irregularly. The direction of the dyke-like bed of hornblende rock is north and south; its decomposition imparts to the soil in its vicinity a red ferruginous colour; the oxide of iron appears, says our author, to enter largely in the composition of the hornblende, since, like other primitive green stones, it affects the magnetic needle. Among the rocks, before reaching Bangalore, gneiss seems to predominate; it is composed of the usual mineral, forming regular strata conformable to each other, in some of which at one time the mica, and at others the quartz, predominates. The quartz is white and transparent, the felspar of a paler hue, and the mica black. Our author now reaches Bangalore, in the vicinity of which gneiss is seen every where, having veins of quartz or of foliated felspar, or of both together, traversing it. It is decomposed to a depth of seventy feet; the loam resulting from it is very abundant all about Bangalore. The clay found is excellent for tiles, bricks, &c.

Dr. Benza notices here a peculiarity in the structure of gneiss; namely, that of splitting, both naturally and artificially, into laminæ, the direction of which is nearly perpendicular to that of the seams of the strata.

"In fact, in the laminæ naturally detached from the rock, we observed that the strata are seen either horizontal, or vertical *on the surface* of them; therefore the laminæ exfoliate in a direction at angles with these strata.

We see in all stratified rocks that they generally split in the direction of the strata; so that the surfaces of separation shew only the surfaces of the seam. But, in the laminæ of this gneiss, the case is different; on the surfaces of the laminæ we see the strata, and their seams along *the surface* of the split, and therefore its direction is at an angle with that of the seams themselves."

The following is worthy of notice.

"It appears that the natives have availed themselves of the peculiarity this gneiss has, of splitting in a direction opposite to that of the strata, to obtain laminæ of any thickness. The process to that effect is very simple and economical. On the convex surface of the gneiss they light a fire, the intensity of which is proportionate to the thickness of the slab to be obtained; and, after having kept it up for such a length of time, as experience has taught them necessary for the required thickness, they extinguish it, and pour cold water on the heated surface of the rock.

This sudden refrigeration producing an instantaneous contraction of the heated portion of the rock, extending as deep as the heat had penetrated, it is detached at that depth

from the parent rock, and the lamina is easily removed, and cut in as many pieces as required.

The curvature of these laminæ being the segment of a very large circle, in the small dimensions they are generally cut, they appear nearly straight, and are used for all architectural purposes, as columns, door-posts, steps, &c.

I have read, I do not recollect where, that the foregoing process is had recourse to, at Bangalore, to split granite. This must be a mis-statement, since at Bangalore, as well as in many other places in India, they use another, and very different, method to split granite, porphyry, green-stone, or other unstratified rocks."

Dr. Benza does not recollect to have ever seen in India the gneiss so well characterized and its strata so much contorted as in this locality. The whole, mass of this gneiss has the usual convex surface; and exfoliates in thick laminæ, portions of which lay, like huge cubic pieces, on the convexity of the rocks. Our author proceeds next to Chinnapatam, a village situated in a plain. Hornblende slate is the rock jutting above the soil near Kingairee and Closepet. Here he found pieces of rock which he was inclined to call porphyry; they were unstratified, composed of semi-foliated felspar, approaching to compact, and glittering—penetrated by numerous microscopic cavities, occasionally filled with a yellow clay, and containing grains of perfectly transparent white quartz, some of them in regular crystals of that mineral. Dr. Benza reaches Mundium, between which and Chinnapatam the rocks are hornblende-slate, intersected in all directions by numerous quartz veins, of divers dimensions and shapes. In its vicinity our author picked up some loose pieces of talc slate, mica-slate, &c. He now proceeds to Seringapatam where he only remained a few hours: he visited the ditch which surrounds the fort, and the bed of the Cavery. the walls of the ditch showed a stratified rock of gneiss, abounding with mica, in a decomposed state; he met with thick beds of silicious slate, traversing the gneiss at different places and in all directions, and supposes it to be what Buchanan calls hornstone, called by the natives *madi-culla*. The strata of this silicious slate have a thickness of many feet,

"And are traversed in all directions by numerous, almost imperceptible, fissures, in the direction of which the rock, when struck, often splits, showing on both surfaces of the separation beautiful, superficial, dendritical appearances, like those occasionally seen in the alpine limestone and in some novaculites (hones) of the clay-slate formation, produced by the infiltration, through the fissure, of the oxide of manganese, at least as far as it regards the limestone.

This silicious schist, besides intersecting, as veins, the gneiss, overlays it in some places, as is seen, on entering the Fort by the Mysore gate, to the right, where it lays in large tabular masses over the gneiss.

A little farther on, going always west, we see masses of hornblende rock, overlaying the two rocks just described. This green-stone, both as blocks and as dykes, I had seen soon after descending into the ditch below the bridge.

This hornblende rock hardly contains any felspar, and it is evidently unstratified—sonorous when struck—of glimmering fracture —and of a black colour. The elegant columns of Hyder's and Tippoo's Mausoleum, beyond Shahar Ganjam in the Island, are of this rock, which however was brought from a different place, as Buchanan informs us, viz. from Cuddahully near Turivicary, about 52 miles from, and N. E. of, Seringapatam, and called by the natives *Carricullu*, or black stone.

Some of the masses of this hornblende rock have a variolated surface, which, however, on breaking the stone, does not *seem* to extend into the interior of the rock. I say *seem*, because, polishing on the stone, the rounded marks re-appear and of a deeper colour than that of the rock itself.

Buchanan took particular notice of these darker spots in the polished rock, and attributed them to the crystals of basaltine (so was augite called at the time he wrote) imbedded in the hornblende; in which conjecture I think him perfectly correct, as the mineral is augite which gives the described appearance to the rock, and it is seen clearly marked in the above mentioned columns of Hyder's Mausoleum.

It must be remarked that the veins of the silicious schist, intersecting the gneiss up to its surface, do not penetrate into the overlying green stone, showing the posteriority in age of the last mentioned rock.

In going out of the Fort through the northern sallyport, close to which Tippoo was killed, you come upon the right bank of the Cavery, which washes the walls of the Fort at this place. When I visited Seringapatam (March 1834) there being very little water in the river, all the rocks forming its beds were exposed to view, enabling me to judge of their nature.

The principal rock in it is gneiss, which appears to extend along the course of this river for a considerable distance; since I have met with the same rock, jutting above

the waters of the same river, at the ferry of Polleapoliam, nearly 100 miles S. E. of Seringapatam. This is one among the many proofs that gneiss is the universal subjacent rock in the table land of Mysore.

Mounting some of the masses close to the outside sallyport, you stand on blocks of a beautiful porphyry of red colour. This rock cuts the gneiss in the bed of the river in an oblique direction N. E. and S. W. across its whole breadth, and is seen continued on the opposite bank, a little below the northern extremity of Wellesley-bridge.

This porphyry is composed of well definedcrystals of red felspar, which occasionally are white, imbedded in a paste of compact felspar of the same colour. Besides these two minerals it contains tourmaline, in numerous needle-shaped crystals distributed through the rock, without having any common direction. The red colour of this porphyritic dyke, through the grey of the gneiss, points it out even from a distance.

Among the numerous pieces of rock, scattered about the western side of the Fort, are found some of a stratified rock of a porphyritic appearance, composed of red felspar, imbedding pieces of white quartz, and having thin veins of beautiful pistachio-coloured actynolite.

Just below the southern extremity of Wellesley-brige, along the right bank of the Cavery, I noticed an enormous accumulation of a friable calcareous tufa, somewhat resembling *osteocolla*, or those calcareous incrustations enveloping vegetable substances, when placed in the course of waters abounding with carbonate of lime. Many pieces were analogous to the nodular kankar found in the plains of India. From what I shall mention hereafter, it appears that some of the tributary torrents to the Cavery contain a good deal of carbonate of lime.

The hill of Mysore I could not visit, but judging from some specimens I have seen from it, it is formed of granite composed of white and rose coloured quartz, white felspar, black mica, and a few garnets."

Our author now reaches Nunjengode, close to which flows a branch of the Cavery. One of the rivulets appears to have its waters overcharged with carbonate of lime, which is deposited all along its course; the high banks of the torrent are formed of calcareous tufa. The deposit is so white, spongy, and light, that it might be mistaken for pumice. Besides a new kind of kankar, our author found, jutting from the soil or loose on the surface, large pieces of ancient kankar which is very different from the modern, being more compact, semi-crystalline, and sparry in the fracture, and concretionary in its structure; in short, very much resembling the ancient *travertino* of Italy. All the blocks along both sides of the Cavery, and projecting above the water are hornblende rocks, with thick veins of quartz, which seem also to be the prevailing rock all over the plain. We now arrive at Goondlapet. Our author at this place examines the different kinds of stones, employed in the construction of the buildings. He found blocks of a very crystalline sandstone, and some of quartz rock; there are stones of a beautiful chloritic porphyry, some of greenstone, of gneiss, of granite &c. The only rock about the place, *in situ*, however, is the actynolite schist to be seen in the lower parts and floor of the ditch. Dr. Benza then reaches Goodloor, which stands at the commencement of the ascent to the Neilgherries, at the foot of a very high hill of the Wynaad group: the blocks about the village are sienitic granite. This brings us to the end of our author's first journey, and here we must part company for the present, under the engagement to accompany him on his second excursion at a future opportunity

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Art. II.—*Notes on Persia, Tartary, and Afghanistan.* By Lieut. Col. Monteith, K. L. S. *Madras Engineers.*

The notes, which we are now about to lay before our readers, Colonel Monteith wrote at the request of a friend at Madras for whom they were intended, and not for publication. But such is the lively interest taken in every thing connected with the country, which is the subject of these pages, that we are satisfied the public will be highly gratified that the author allowed his intentions to be changed, especially when we state that his nineteen years' residence in Persia enabled him to become personally acquainted with many of the chiefs of their tribes: he had also frequent communication with Tartars, and some of the Russian Mission to Bokhara. Under these circumstances we are sure our readers will be anxious to peruse his own interesting account.

"The Caspian provinces, subject to Persia, consist of Talish, Ghilon, Mozanderan, and Astrabad. The nature of the country, character of the people, their language, and general appearance, and even the cattle of the country, form a strong contrast to the other parts of the empire, much more resembling those of India.

The mountains which divide them partake of this difference. The sides looking towards the Caspian are wooded nearly to the summit, and the others are bare, rugged, and parched, the leading features of Persian scenery. The elevation of the range being about 7,000 feet, every degree of temperature is experienced. The low country near the Caspian bears, as is before mentioned, a strong resemblance to India; the charge of unhealthiness only applies to the swamps in the vicinity of the sea. After a slight ascent the climate is particularly fine, and from its dampness much resembles England, producing perpetual verdure. The strength of the country, through which a stranger cannot find his way, has generally saved it from foreign invasion. Its inhabitants felt few of the calamities which afflicted Persia, from the Afghan invasion to the establishment of the Kadgar dynasty, by whom Mozanderan and Astrabad have been particularly favoured, being considered their immediate patrimony, and the cradle of the Shea sect.

The people, in consequence, are generally richer and better lodged. A traveller passing through the country, would form a very false idea of the population and real extent of cultivation; the people, enjoying great security among themselves, and being seldom visited by travellers, are not obliged to assemble in large villages, but are dispersed in houses, three or four together, over the country, always at some distance from the roads, or, rather, difficult paths, which traverse the rice fields and swamps. These are purposely kept in a difficult state, as well for protection, as to secure the monopoly of the carriage, no cattle being able to convey loads but those of the country. If a stranger, however, has a quarrel with any of the inhabitants, or attempts to press a guide, he will be soon convinced, by the assembly of a crowd about him, how great the number of people really is.

On the death of the King, or in case of foreign invasion, a few guards in the passes secure these provinces from the miseries to which the rest of the country is exposed, and the news brought by fugitives is all they know of passing events; without they send forces to the aid of the contending parties. The Kadgars owe their reign in Persia to the troops of Mozanderan and Astrabad. In the latter district the chief part of their tribe (Kadgars) has long been fixed, and forms its guard against the Turkoman Tartars. They formerly were established on the Goorgan river, but have been gradually dispossessed of the lands on its banks, and forced to retire near the forest districts, where the Tartars seldom venture in force.

Russia gained possession of all the Persian provinces on the Caspian by treaty with Shah Sultan Hussain, in the time of Peter the Great, on condition of assisting that prince against the Afghans and Turks. She never fulfilled her part of the engagement, and these districts were restored to Nadir Shah on his return from India. During this partial occupation a great number of men died from fevers, and Russia found none of the advantages she expected, either from the silk of Gilan, or sugar of Mozanderan. Their possession is still a favourite object with her, under the idea that they will render her independent of other countries for those valuable products, but in this I think she would be much disappointed."

The foregoing exhibits our author's style. There is a want of arrangement which critics have to complain of even in our best writers; and as Colonel Monteith's narrative is intended more for a fire-side account of all he witnessed and felt than for a well digested treatise, allowances should be made; but we hasten to introduce the reader to his account of the Tartar tribes.

"The three Tartar tribes of Goulkan, Yamout, and Tekie, are decidedly Persian subjects; like all frontier tribes they pay less respect to the orders of Government than those settled in the interior of the country, and, for some time, but little of any kind, owing to the weak and pacific character of the late king. I have, however, seen about 3,000 of their best horse, serving with the Persian army, of whom 1,000 were Tekies, and attached to the Erivan force, where I commanded the Artillery. During the winter the greater part of these are encamped in the Persian territory, and on the Ottrak and Goorgan, the Persians can then do what they please, and they seldom venture to disobey orders, as they could not fly into the desert without abandoning their families, winter provision, cattle and property; and what they did carry off would be plundered by the other Tartars, whether of Khiva or Bokhara, if they had not previously entered into engagements with them. The subjoined list gives the names of the different tribes, who form the principal and most formidable part of the Persian Cavalry, their principal force. The Infantry are either from the fixed villages or the great tribes of Lack, Loor, and Boktearee (supposed to be the remains of the ancient Persians). This system renders the assembly of an army a matter of no difficulty, but keeping such a force in order, or even together for any length of time, requires a Prince of great firmness and talent, as in times of confusion the influence of these tribes is greatest, and a civil war is easily brought on and difficult to be subdued. Persia has always been a country not difficult to conquer in times of civil dissension, but, from the same cause, impracticable to retain. When the country is well roused, no army can long resist the incessant attacks of a force, always present, and never to be encountered. The nature of the country singularly favours this system of war; half of it is only fit for the abode of pastoral tribes, who care little for a change of residence, if it does not take place in winter, or at the time their flocks

are bringing forth, when a march is destructive to their property. From the long and inveterate feuds which have existed between many of these communities, it is not difficult to form a party; but they soon get tired of any foreign power, and return to their own people. With one of a different religion, no dependence can be placed on their alliance.

The kings of Persia have always had the greatest difficulty in keeping them in subjection. Shah Ismail and Shah Abbas attempted to form a royal tribe, called the Shah Pussunds, or Shasewunds, by taking volunteers from all and giving them the best lands. The measure was not successful, and they quickly became the most unruly body in the kingdom. Nadir Shah being an Afshar, that tribe rose to great power under his family; to them succeeded the Zunds, of which Kerim Khan was the chief, and now the Kadgars. The present family have much reduced the power of the tribes, by raising regular troops and a corps of Artillery. This, with the party they are able to form, has been sufficient to restrain all but those of the province of Khorasan; had Abbas Mirza, lived that too would have been perfectly subdued. In Azerbijan, formerly the most turbulent province, no tribe dares disobey the orders of government; but oppression has followed, and, in the late wars with Russia, theytook no part in the struggle, and joined General Paskewitch's forces after the fall of Tabreez."

Colonel Monteith says that travellers are much deceived as to the resources of Persia; they merely judge ofits population and fertility from whatthey see in passing through it; but he adds that a considerable part of the country is desert. Alluding to cultivation, he observes that it generally depends on irrigation: in the plains water is seldom to be met with; fortunately, however, the rain is sufficient for vegetation. The want of population is best shown by our author's statement that one may march for days and not see a single village. This, however, appears to be no inconvenience to travellers; for, from our author's account,the traveller is able to procure every supply from the keeper of the caravanserai. The cheapness of bread and meat is truly astonishing. Colonel Monteith states that 40 lbs. of bread for a rupee is considered high, and that 10 lbs. of excellent mutton may be had for the same price. The villages which supply these things are ten miles to the right and left. On the subject of supplies to marching armies, the following under existing circumstances is of deep importance.

"An army, under the Persian government, would be directed to assemble at a certain point in some fertile district, and but a small part would follow the high road. The Khorasan troops annually come to the camp at Sultania, and 30,000 pilgrims pass the same way; they all purchase provisions without difficulty. An invading army could be deprived of this advantage, and it would be necessary to march by several parallel columns, joining at certain towns, where a large stock of provisions is always kept. An army should therefore have one month's supply of provisions (biscuit is better than grain or flour). When the crops are on the ground, forage for the cavalry will be procurable, and the *country* ruined, and a famine generally follows the passage of a large army, if arrangements have not been made for at least one year before, and the meadows strictly preserved in the line the troops take.

The country between Russia and Persia, to the east of the Caspian and sea of Aral, is generally considered a desert, though formerly it comprised the powerful kingdom of Khorasan, and several parts of it, as Bokhara, Sameraud, Ko Khan, &c. are described as the most agreeable residencies in the vast empire of Timur, abounding in great and flourishing towns, and frequented by merchants from every part of the world. It is at present much more thickly inhabited than is generally supposed, but, the population being principally migratory, it presents a very different appearence, according to the season of the year. In winter the low lands are covered with tents, where in summer not a soul will be seen, all having gone to the mountains or upper part of the rivers near Ala Taug.

Russia first settled the present government of Orenburg, and established the line of the Yaik, or Oral, in 1730. It was at that time infested by the Cossack pirates who had fled from the Volga, and, joining the Baschiers and other Tartars, made irruptions into the neighbouring provinces. The town of Orenburg was then founded, and a line of forts drawn from the Caspian to the great chain of the Aral mountains. The Cossacks and Baschiers were taken into the service of Russia, and formed into 12 regiments of 500 men each, to whom were granted lands, a small pay, and freedom from taxes.

They have since been good subjects, and opposed the great Kalmook emigration, which, however, they were not able to prevent; the 60,000 families of whom forced the line and retired into China. The line was subsequently reinforced with 12,000* regular troops and artillery; settlers arrived from Russia, and it is at present one of the most fertile provinces supplying Ashterkhan and other places, with a vast quantity of grain and provisions. The finest horses, and most numerous studs, are also kept here.

* Now more considerable, said to be near 30,000 men.

This extension brought Russia in contact with the Kirgis Tartars, generally called Cossacks, the most powerful of all the tribes of Khorasan. After several years' war, peace was concluded in the latter part of the reign of Catherine the 2d, and the tribes were allowed to pasture their cattle in the mountains forming the Russian boundary, on acknowledging the sovereignty of that power, which is content with a nominal rule, and the right of confirming the election of the Khan. They voluntarily furnished 5,000 horse during the French invasion, and, in the days of their power (they have not now half that number), counted 200,000 tents. To the west and north of the lake of Aral are the Kara Kalpaks, or black cap Tartars, by whom the greater part of the Russian subjects are carried off and sold as slaves in Khiva; they profess themselves under the rule of Russia. To the south of these are the Aral Tartars, extending to Khiva; and the Persian Turkomans, who are not numerous and always live in fear of their more powerful neighbours. The whole of these are wandering tribes, but they cultivate a small part of their lands, which in many places are far from being barren deserts.

To the east of the Aral lake are several small states of the Usbecks, who pride themselves on being the descendants of Gengis and Timur; some of these are within the Chinese territory, which, notwithstanding its reported weakness, is gradually extending in this direction. The most powerful is Kashgar, from whence there is a direct communication with Cashmeer and Bengal, across the great Hindu Cush and Tibet. I have seen a Russian Armenian subject who had made several journeys to both places.

Kokhan, or more properly Koo-Khan (the Lord of the mountains), has several considerable towns, and a great number of villages, with fixed inhabitents, along the Sir Derria river and its branches. The chief of this country exercises a great influence over all the mountain tribes of the Ala Taug. The Chinese are pressing on his independence, and he will probably soon be subject to that empire.

Badakshan is frequently, but improperly, included among the Tartar states, and has sometimes made nominal submission to Bokhara and Cabsel. The nature of their country, which is extremely mountainous and difficult, protects them from foreign invasion. Through it lies a good summer road to Cashmeer, which caravans from Bokhara generally take. The people generally speak Turkish, but they more resemble Afghans than Tartars, and are extremely bigoted, and unfriendly to strangers; they may amount to 30,000 families and are celebrated as very brave infantry, of which their force is almost entirely composed. Merchants give them a good character for honesty."

We must here conclude: in our next, we shall give our author's opinion on the question of the Russian invasion of India.

Art. III.—Discovery of the Genuine Tea Plant in Upper Assam.

Memorandum of an Excursion to the Tea Hills, which produce the description of Tea known in Commerce under the designation of Ankoy Tea. By G. J. Gordon, Esq.

Journal of an attempted Ascent of the river Min, to visit the Tea Plantations of the Fukhin Province of China. By G. J. Gordon, Esq., *Secretary, Tea Committee.—Journal of the Asiatic Society of Bengal.*

The above articles open with a correspondence of the Tea Committee to the Government of India. The first are reports from Capt. Jenkins and Lieut. Charlton, forwarding samples of the fruit and leaves of the tea plant of Upper Assam which proved beyond doubt that the tea shrub is indigenous in Upper Assam, being found from Sadiya and Beesa to the Chinese frontier province of Yunnan, where the shrub is cultivated for the sake of the leaf. This discovery, the most important and valuable yet made in matters connected with the agricultural or commercial resources of this empire, the Tea Committee ascribe to the indefatigable researches of the two officers, the authors of the reports to which we have alluded. The Committee, however, add that they were acquainted with the fact so far back as 1826. The late Dr. David Scott sent down from Munipore specimens of the leaves of a shrub which he insisted was the real tea. We beg also *en passant* to observe that we found precisely the same tea at Sandoway in Arracan in 1827 specimens of the leaves, and a plant in its natural soil, we forwarded from that place for the Governor General's garden at Barrackpore. Our report at that time was considered to be of sufficient importance to induce Lord Amherst to place it on the public records, and to forward a copy for the information of the Hon'ble the Court of Directors.

The Tea Committee go on to observe that it was known to them that several species of camellia were natives of the mountains of

Hindustan, and that these were indigenous in our north eastern frontier provinces Taking into consideration the close affinity between the two genera, they were disposed to expect that the alleged tree would prove nothing else, but some sortof camellia. Having obtained however the fruit of the Sadiya plant they were able to state with certainty that it was a genuine tea—th^ identical tea of China, which is the exclusive source of all the varieties and shades of the tea of commerce. The following sketch exhibits the peculiarities in the structure of the fruit on which depends entirely the difference between the tea and camellia. We give the sketch with explanatory remarks, in order that our readers now in Rambree and Sandoway may be able to extend their researches.

Memorandum explanatory of the sketches which accompany the report of the Committee of Tea Culture.

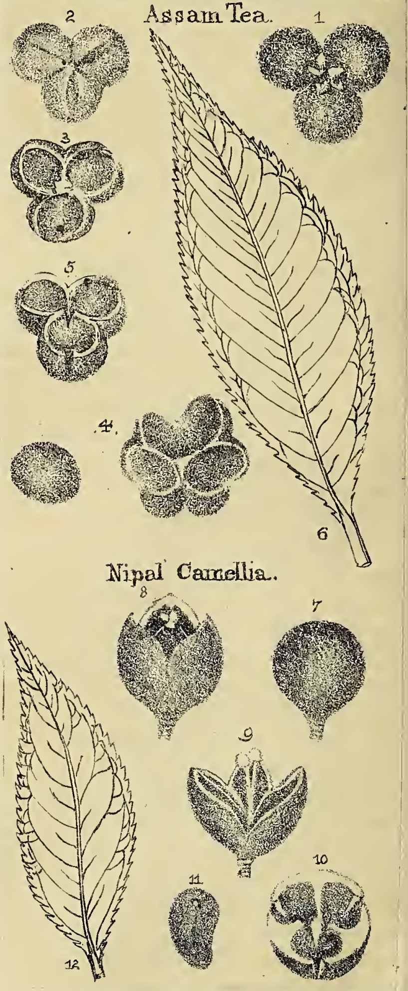
There is no danger of mistaking any plant for the tea except the camellia. Both are very closely allied to each other in general appearance, in the form of their leaves, and the structure of the flowers. It is by the character of the fruit alone that they can be satisfactorily distinguished for practical purposes. in that respect the two genera differ very widely.

In both the fruit consists of a roundish, more or less triangular, dry capsule, of three distinct cells, containing one solitary seed or nut. At the period of maturity the dehiscence or bursting takes place vertically, by means of three fissures, extending from the top of the capsule towards its base. So far their capsules are precisely alike ; the following are the points of difference.

In the tea, the capsule is more or less deeply divided into three globular lobes, sometimes appearing as if it consisted of three round capsules united into one. The general outline is therefore always decidedly triangular, with extremely obtuse corneas. The bursting proceeds along the middle of the lobes or angles, when a large seed is discovered through each aperture enclosed on all sides within its proper cell, which cell is in fact formed by the corresponding lobe of the fruit. By this process six valves are, properly speaking, formed, (and not three, as they are generally counted,) each lobe splitting into two hemispherical valves. The partitions alternate with the lobes, and are formed by the sides of two adjoining cells being, as it were, glued together, and extending to the axis of the capsule, from which they at length completely detach thsmselves, when it disappears altogether. The seeds or nuts are almost globular.

In camellia the capsule is very obscurely triangular without any tendency to become deeply three-lobed. It bursts along the middle of each side (consequently alternately with the corners) into three very distinct valves, each of which belongs to two adjoining cells, because the three partitions originate lengthwise from the middle of the respective valves, and are therefore opposite or contrary to these, converging from thence to the triangular axis, from which they gradually separate, leaving it finally unconnected and free. The seeds are of an oval oblong shape, smaller than those of the tea.

The preceding remarks are made with reference chiefly to the Assam tea and the Nipal camellia; and purposely without technical precision, the object being simply to convey a general idea of the structure of the two sorts of fruit. But they admit of being applied to all other instances of comparison between the genera in question.



Reference to the Figures in Plate III.

A The Assam tea. *Figs.* 1, 2, 3, ripe capsules scarcely enlarged; at 1, seen from below, deeply three lobed; 2, the common from commencing to burst; 3, the same completely burst open, and discovering the seeds; 4, the same, the seeds being removed, and one of these represented separately; of the natural size; 5, the lower half of a ripe capsule divided by an horizontal section and the seeds removed, exhibiting the places of dehiscence along the angles or lobes, and the partitions alternating with these and separating from the axis; a little enlarged; 6, outline of a full-grown leaf, of the natural dimensions.

B The Nipal camellia (*C. kissi*). *Fig.* 7, ripe and entire capsule slightly enlarged; 8 and 9, the same after bursting, the free axis being seen in the last figure; 10, a horizontal section as in the tea, much enlarged, representing the places of bursting, which alternate with the angles of the fruit, the partitions which are opposite to the angles of the fruit, and the valves, separating from the free axis; 11, a detached seed, natural size; 12, outline of a full grown leaf.

(Signed), N. Wallich, M. D.
Off. Sec to the Com. to Tea Cult.
H. C. Bot. Garden, Dec. 24, 1834."

On the grounds of the important intelligence to which we have alluded, the Committee recommended to the particular consideration of the Government, that a deputation of scientific men be sent to Upper Assam for the purpose of collecting on the spot the greatest variety procurable, of botanical, geological, and other details, preliminary to ulterior and successful measures being taken with regard to the cultivation of the tea shrub in that country. Captain Jenkins states that the soil where the trees grow is alluvial; they rise to the height of twelve or fifteen feet, at the foot of a low range of hills or a small distance up the hills; but never on the summit, from which he inferred they required a sheltered situation. The aspect was gnerally southerly or south east. The leaves about two inches in length and one in breadth, alternate, elliptic, oblong, and serrate; the flower white, very like that of the white wild rose, but much smaller. The editor of the *Asiatic Journal* states that, in 1828, Captains Grant and Pemberton sent specimens of the tea plant from Manipore to Mr. Secretary Swinton. They made tea from a decoction of its leaves, and found it approach very nearly in flavour the ordinary black tea.

We learn that Mr. Gordon anxious to have an opportunity of personally inspecting the tea plantations in the black tea district, next in celebrity to the Bohea hills, determined upon visiting the Ankoy hills and Hwuy Taou bay, he, in company with Messrs. Gutzlaff, Ryder, and Nicholson, proceeded in a ship's long boat towards the head of the bay where the town of Hwuy Taou is situated. We pass over the account of the journey, but bring our readers at once to the end and object of it.

"Arrived at Taou-ee. We were hospitably received by the family of our guide, and soon surrounded by wondering visitors.

Mr. Gutzlaff speedily selected one or two of the most intelligent of them, and obtained from them ready answers to a variety of questions regarding the cultivation of the plant. They informed him that the seed now used for propagating the plant was all produced on the spot, though the original stock of this part of the country was brought from *Wae-eshan*; that it ripened in the 10th or 11th month, and was immediately put into the ground where it was intended to grow, several being put together into one hole, as the greater part was always abortive; that the sprouts appeared in the 3rd month after the seeds were put into the ground; that the hole into which the seeds were thrown are from three to four inches deep, and that as the plants grow the earth is gathered up a little round their root; that leaves are taken from the plants when they are three years old, and that there are, from most plants, four pluckings in the year. No manure is used, nor is goodness of soil considered of consequence: neither are the plants *irrigated.* Each shrub may yield about a *tael* of *dry* tea annually (about the 12th of a pound). A mow of ground may contain three or four hundred plants. The land tax is 300 cash (720 dol.) per mow. The cultivation and gathering of the leaves being performed by families without the assistance of hired labourers, no rate of wages can be specified; but as the curing of the lead is an art that requires some skill, persons are employed for that particular purpose, who are paid at the rate of 1 dl. per pecul of fresh leaf, equal to five dollars per pecul of dry tea. The fire-place used is only temporary, and all the utensils as well as fuel are furnished by the owner of the tea. They stated that the leaves are heated and rolled seven or eight times. The green leaf yields one-fifth of its weight of dry tea. The best tea fetches on the spot 23 dls. per pecul, (133⅓ *lbs.*) and the principal part of the produce is consumed within the province, or exported in baskets to Formusa. That the prevailing winds are north-westerly. The easterly winds are the only winds injurious to the plants. Hoar frost is common during the winter months, and snow falls occasionally, but does not lie long nor to a greater depth than three or four inches. The plant is

never injured by excessive cold, and thrives from 10 to 20 years. It is sometimes destroyed by a worm that eats up the pith and converts both stem and branches into tubes, and by a gray lichen which principally attacks very old plants. The period of growth is limited to six or seven years; when the plant has attained its greatest size. The spots where the tea is planted are scattered over great part of the country, but there are no hills appropriated entirely to its culture. No ground in fact is formed into a tea plantation that is fit for any other species of cultivation, except perhaps that of the dwarf pine already alluded to, or the Camellia Obeifora. Mr. Gutzlaff understood them to say that the plant blossoms twice a year, in the eighth moon or September, and again in winter, but that the latter flowering is abortive. In this I apprehend there was some misapprehension, as seed of full size, though not ripe, were proffered to me in considerable quantities early in September, and none were found on the plants which we saw. I suspect that the people meant to say that the seeds take eight months to ripen, which accords with other accounts. We wished much to have spent the following day (the 13th) in prosecuting our inquiries and observations at Tawand and its neighbourhood, but this was rendered impracticable by the state of our finances. We had plenty of gold, but no one could be found who would purchase it with silver at any price. We therefore resolved on making the most of our time by an early excursion in the morning previous to setting out on our return.

We accordingly got up at day-break and proceeded to visit the spot where the plants were cultivated. We were much struck with the variety of the appearance of the plants; some of the shrubs scarcely rose to the height of a cubit above the ground, and those were so very bushy that a hand could not be thrust between the branches. They were also very thickly covered with leaves, but these were very small, scarcely above $\frac{3}{4}$ inch in length. In the same bed were other plants with stems four feet in height, far less branchy and with leaves $1\frac{1}{2}$ to 2 inches in length. The produce of great and small was said to be equal. The distance from centre to centre of the plants was about $4\frac{1}{2}$ feet, and the plants seemed to average about two feet in diameter. Though the ground was not terraced, it was formed into beds that were partly levelled. These were perfectly well dressed as in garden cultivation, and each little plantation was surrounded by a low stone fence, and a trench. There was no shade, but the places selected for the cultivation were generally in the bottoms of hills, where there was a good deal of shelter on two sides, and the slope comparatively easy. I should reckon the site of the highest plantations we visited to be about 700 feet above the plain, but those we saw at that height and even less appeared more thriving, probably from having somewhat better soil, though the best is little more than mere sand. I have taken specimens from three or four gardens. Contrary to what we had been told the preceding night, I found that each garden had its little nursery where the plants were growing to the height of four or five inches, as closely set as they could stand; from which I conceive that the tea plant requires absolutely a *free* soil, *not wet* and *not clayey*, but of a texture that will retain moisture; and the best site is one not so low as that at which water is apt to spring from the sides of a hill, nor so high as to be exposed to the violence of stormy weather. There is no use in attempting to cultivate the plant on an easterly exposure, though it is sufficiently hardy to bear almost any degree of dry cold.

By half-past 10 A. M. we set out on our return, in chairs which we were fortunate enough to procure at this village, and reached the banks of the river at Aou-ee a little before one o'clock. In the first part of our way we passed by some more tea plantations on very sterile ground. One in a very bleak situation, with nothing but coarse red sand by way of soil, seemed to be abandoned."

Our author in his next communication gives an account of his attempt to ascend the river Min, to visit the plantations of the Fakhin province of China, but he and his party met with so much opposition (there lives being in peril) that they were compelled to return.

We must refer our readers to our last journal (page 301) for further discoveries of the tea plant in Assam. It is sufficient to add that a considerable number of Chinese cultivators have been obtained; they arrived at Sadiya in Upper Assam on the 3rd of last month, so that we may expect tea in abundance.

Art. IV.—Cultivation of Cotton, By W. BRUCE, *Esq. Remarks on the culture of Cotton in the United States of America, Capt.* BASIL HALL'S *Travels. Remarks on the best method of cultivating New Orleans Cotton. Ibid. Regarding the cultivation of Cotton, Ibid. On the cultivation of Cotton in Central India, By Baboo* RADHAKANT DEB. *Observations on the culture of Cotton in the Doab and Bundlecund, By* W. VINCENT, *Esq. On the artificial production of new varieties of Cotton, By* H. PIDDINGTON, *Esq. On the method used in Cayenne to preserve the Cotton plant.*

On a specimen of Cotton gathered in the Boglepore district from a shrub in its wild state, by F. HUNTER.
Use of the Sawgin, by F. MACNAUGHTEN, *Esq. Cotton of Ava. Cotton of Cachar, by Capt.* S. FISHER. *On Cotton grown in Cuttack, and its staple for spinning, by* M. T. WEEKES. *On the native Cotton produced in the Garrow Hills, by Capt.* A. BOGLE. *Report on specimens of Cotton reared by Col.* COOMBS, *at Palaveram. On the cultivation of Upland Georgia Cotton at Allahabad, by Mr.* W HUGGINS. *On the cultivation of Pernambuco Cotton at Tavoy, by* W. MAINBY, *Esq. On the cultivation of Sea Island Cotton in the district of Cuttack. On Upland Georgia and Sea Island Cotton.—Transactions of the Agricultural & Horticultural Society of India, Vol.* 11. 1836.

(Concluded from page 265.)

The next communication is from Thos. Fisher Esq. from Cachar, where the quality of the cotton is not deemed fine, but from which cloth is made both warmer and finer than that fabricated from the cotton grown to the westward. It is cultivated on a hilly land contiguous to a navigable river which according to Mr. Fisher, offers considerable advantages to the cotton grower. Mr. Lamb of Dacca forwards samples of cotton from the neighbourhood of Dacca: these are discoloured and ill-looking from having been kept for months in the smoky huts of the owners; the staple is short, and the seeds form an unusually large proportion of the weight of the raw material. Mr. Lamb believes that more favorable specimens may be produced by careful search among the dealers, yet at the best it will be inferior to the American and Bourbon cottons. The finer threads are not now produced, and there has been a great falling off within these few years. Mr. Lamb observes that—

"The cotton from which the fine Dacca Muslin is manufactured, is cultivated on both banks of the Megna and Ganges, near their junction and on the low lands between those rivers.

It is an annual plant, and in good soil grows to the height of four or five feet, but it is generally too closely set to admit of its branching out well.

It is sown in October and November. The seeds are wetted for a few minutes, then dropped by the hand into the ground in drills from 16 to 20 inches apart.

When the plant has attained the height of five or six inches, the ground is carefully hoed up on both sides and kept clean by repeated weeding.

The crop is gathered in April, May, and June, and where the situation chosen is beyond the reach of the inundation, a second crop, but inferior both as regards quantity and quality, is obtained, but more generally the land is inundated and produces only one crop of from ½ to 2 mds. of undressed cotton from the beegah.

Some of the more industrious ryuts contrive to have a subsiding crop from the ground by sowing rice in the spaces between the drills, a few weeks before the cotton is removed, the rice rising with the water.

The cotton crop does not at present seem to be in favour with the farmers; it is an uncertain one, being liable to injury from insects in the early months from hail and rain when farther advanced, and from being mostly cultivated on low lands, it is not frequently destroyed by the river in June before the produce can be gathered.

The cultivation has declined with the muslin trade, and the price obtained is now scarcely remunerating; it has fallen from 5 lbs. to 3½ within these few years.

For the finer thread the hand is used in separating the seeds from the cotton; indeed the cylinders employed here are so ineffective and the cotton adheres so strongly to the seed, that an active person will do nearly as much work with the hand alone as he can do with the aid of the machine in common use.

Accompanying I do myself the pleasure to send you a few samples of the cotton and of the thread (the better qualities) spun from it. From the enclosed extract from the books of the Custom House, you will perceive that little or no cotton is introduced from Ava. The imports noted as 754, 284, and 3111 mds. include both what is brought by the Burmah boats, and the supply from our own provinces. The imported cotton is only used in the coarse manufactories, and if there be any considerable importation of cotton from the Ava territories it is absorbed in Chittagong and about Luckipore among the baftah weavers; but I have great reason to believe that the importation is altogether trifling.

Cleaned cotton or rooie passed the Custom House – Dacca.

	Imported.		Exported.	
	mds.	*srs.*	*mds.*	*srs.*
1828-29, ...	19	20	255	17
1829-20, ...	0	14	132	25
1830-31, ...	1	21	50	0

This report does not include the principal import of cotton from the Western Provinces which being covered by Rowannahs from Mirzapore, Patna, or Moorshedabad, is not entered in the books of the Custom House at Dacca.

Account of Capause (cotton) passed the Dacca Custom-House, during the years 1828 29, 1829 39, *and* 1830-31.

Years	*Article Undressed cotton.*	*Quantity Imported*	*Quantity Exported*	*Total.*
1828 29.	Capause,	754 34 8	5,215 20 0	5,970 14 8
1829 30.	Ditto ..	284 3 8	6,102 20 0	6,386 23 8
1830 31.	Ditto,	3,111 34 4	1,839 18 0	4,951 12 4
			Maunds	17,308 10 4

Our next paper contains remarks on Bourbon cotton grown at Cattack, and its staple for spinning, communicated by Mr. J. T. Weekes. This gentleman states that a beegah of land might be made with little trouble to nett upwards of 20 rupees per annum. In a beegah of ground containing about 320 plants, he made nine pieces of cloth, each piece 1 yard wide, 12 in length, making a total of 108 yards. The expense in making was one rupee eight annas for each piece; in making the thread 12 annas, and to the weavers 12 annas, the selling price of which is 3 rupees 12 annas. The writer adds—

"That a piece of cloth of equal length and breadth might be made by a Native for 1 Rupee, my calculation then stands thus:

Rent of 1 beegah of good land, ...	Rs.	4
This beegah will contain between 6 and 700 plants, which will produce cotton, annually, for 20 pieces of cloth, ...		20
Total expense to a Native farmer, ...	Rs.	24
Selling price of the above cloth, ...		60
Profit,	Rs.	46
Deduct half for any possible errors, accidents &c. &c.		23
Nett annual profit on 1 beegah, ...	Rs	23

My having made 9 prieces from half a beegah of inferior soil without any trouble or care places the correctness of my calculation beyond dispute, and the fact only requires to be made known, by a few hundred notices in Nagree and Bengalee, and distributed to all the Collectors with instructions for publicity being given to them to the Mokuddums and other heads of villages within their Collectorate, to attract the notice of the Native community. I believe there is no difference between the Bourbon cotton and that denominated Sea Island, and I never saw plants more hardy or require less care. Putting the seed into the ground at the commencement of the rains (which should be well turned up) is the principal part of the labour, in 85 days the plants will be in flower, and cotton may be gathered 9 months in the year, and they will continue 8 or 10 years: mine were planted in 1827, and from the produce I have annually made pillows, bedding, &c. &c. but was resolved during the past season on ascertaining the annual value of half a beegah, which has given the result now communicated. I should observe that at the commencement of the rains of each year I take the shears and clip the plants down to about 4 feet, their average height at the close of the rains will be about 7 feet. I have frequently transplanted them during the rains when in full leaf and bud and saved the gathering. One man is capable of taking care of 2 beegahs. A muster of the cotton accompanies."

The next paper is from Capt. Bogle on the native cotton produced on the Garrow hills. The Garrows inhabit an extensive tract of the Gowalparah district, and are dependent for subsistence on the means of barter, which the growth of cotton amongst their hills enables them to carry on with their neighbours in the plains below, who again export it to the adjoining districts of Assam, Rungpore, Dinapore, Mymunsing, Dacca, &c. &c. The cotton grown is of that description called cupass or the desee cotton, which is commonly grown throughout the countries to the eastern side of British India, and more or less throughout Lower Bengal and some parts of the Coromandel Coast. It is coarse and short in fibre, and very difficult of separation from its seed; and, although strong in its nature, especially when very fresh, it possesses no other desirable quality for the machine-spinner. The seed is small in size, furred over with a yellowish green fur, and abundantly covered with wool. The soil and climate of its site of culture would be favorable to the growth of new and better kinds of cotton, and which would rank higher in value by from 50 to 100 per cent. Some specimens of cotton have been imported from Liverpool, with the following particulars of prices.

"Specimens of sundry cottons as undermentioned, forwarded by Messrs. Daniel and Thomas Willis, of Liverpool, to Messrs. Willis and Earle, of Calcutta, and received per the *Samuel Brown* in the month of May, 1832.

Their several values are affixed as separately estimated by two eminent Liverpool cotton brokers in the month of October, 1831.

ESTIMATED VALUE.

Per Messrs. Salisbury, Turner, and Earle, Brokers, Liverpool, October, 1831.

Sea Island.	d.
No. 1 Common,	10
2. Good,	13
3. Fine,	18
4. Very fine,	2-6
Egyptian.	
No. 1. Middling,	7¼
2. Good,	8
3. Fine,	9
Orleans.	
No. 1. Ordinary,	5¼
2. Good fair,	7
3. Fine,	8
Bowed.	d.
No. 1. Ordinary,	5
2. Fair,	5⅝
3. Fine,	7
Mobile.	
No. 1. Ordinary,	5
2. Good fair,	5¾
3. Fine,	6¾
Pernambuco.	
No. 1. Middling,	7¼
2. Good fair,	7⅞
3. Fine,	8¾
Bahia.	
No. 1. Ordinary,	6
2. Fair,	6⅝
3. Good,	7
Maranham.	
No. 1. Middling,	6¾
2. Fair,	7¼
3. Fine,	7⅝

Per Messrs. Salisbury, Turner, and Earle, Brokers, Liverpool, October, 1831.

Demerara.	
No. 1. Middling,	7
2. Good,	8
3. Very fine,	10
Surat.	
No. 1. Middling,	3⅛
2. Good fair,	4¼
3. Good,	4¾
Bengal.	
No. 1. Middling,	3½
2. Good fair,	[illegible]
3. Good..	4¼

Per Messrs. Molyneux, Taylor, and Co. Brokers, Liverpool, October, 1831.

Sea Island.	*d.*
No. 1. Mid. quality, per lb.	10½
2. Good ditto	13
3. Fine ditto	18
4. Extra ditto	2-3
Egyptian.	
No. 1. Ordinary quality	7¼
2. Fair ditto	7¾
3. Good ditto,	8½
Orleans.	
No. 1. Very middling ditto	5¼
2. Good ditto	7¼
3. Prime ditto,	7¾
Bowed.	
No. 1, Ordinary quality	4⅞
2. Fair ditto	5⅝
3. Good ditto..	6¾
Mobile.	
No. 1. Ordinary quality..	4¾
2. Middling..	5⅜
3. Good ditto,	6⅛
Pernambuco.	
No. 1. Middling quality	7½
2. Fair ditto	7¾
3. Good ditto..	6½
Bahia.	
No. 1. Ordinary quality..	6
2. Middling ditto	6¼
3 Good fair ditto..	7
Maranham.	
No. 1. Middling quality	7
2. Fair ditto	7¼
3. Good ditto..	7½
Demerara.	
No. 1. Fair quality..	7¼
2. Good fair ditto..	7¾
3. Good ditto..	8½
Surat.	
No. 1. Ordinary quality, ..	3⅛
2. Fair ditto,..	4⅜
3. Good ditto.. ..	4¾
Bengal.	
No. 1. Ordinary quality,..	4
2 Ditto ditto,..	4
3. Good fair ditto..	4⅜

(A true copy)

WILLIS AND EARLE.

Calcutta, 30*th June*, 1832.

For the use of the Agricultural Society, Calcutta."

The next report is from Colonel Coombs, at Palaveram near Madras: the specimen furnished is from plants grown on the hill on which he resides, five miles from the sea-coast and about 400 feet above the level of the sea. Another specimen is from plants grown at the foot of the same hill. The plants appear to have thriven well: the file or fibre is strong and long, possessing a good deal of fineness, and it bears the hue of what is termed healthy and well grown cotton; it is likewise gathered in a remarkably clean manner, and would be much esteemed by our machine spinners. It is valued in Liverpool at *7d.* to *7½d.* sterling per pound. The cotton grown at the foot of the hill is of middling quality, the fibre is shorter, weaker, and rather finer than that of the hill cotton; neither is the hue quite so good.

The last report is from Mr. Huggins at Allahabad. The cotton was raised from Upland Georgia: he raised the plants in May, and as soon as the rains set in he transplanted them into beds which he had prepared with two or three ploughings at the distance of five feet each way. The plants during the rains grew very rapidly, and began to burst their pods early in October.

Art. V.—Comparative View of the External Commerce of Bengal, during the years 1834-35, *and* 1835-36, *accompanied with tables, illustrative of the extent of trade carried on with each country and state, by* JOHN BELL, *Superintendent of Inspectors, &c. Royal Octavo, pp.* 106, 1836. BAPTIST MISSION PRESS.

(*Continued from page* 267.)

Mr. Bell next proceeds to give a review of the exports, which will be important to our readers, particularly in Europe, to whom by the way we strongly recommend the work itself. It appears there has been 27 per cent increase on the whole amount of export trade, and our author adverts to the abundance of other resources which only require increased capital to draw them forth. We are satisfied in our own mind that the Government has not yet learnt the grand principle of employing capital to enrich itself and the members of the community: if the revenue be largely employed in developing the powers of production in the country, even those who are least acquainted with the soil and the climate will assent to the

assertion that the resources are unquestionably inexhaustible. We agree with Mr. Bell that the amount of the external commerce of Bengal is now perfectly contemptible compared with what it might be. Our author is, and we admire him for it, enthusiastic in his expectations, that the effect of the abrogation of the Company's trading charter the abolition of the transit duties, and the impetus that will be given to the export trade, when the home duties on sugar will have been equalized, will work wonders.

Mr. Bell reprobates, and very justly, the idea that India has nothing to offer in return for an extension of imports. He acknowledges that the successful extension of imports has been checked and occasional "gluts" in some particular branches produced; but since the "avenues—

"To an immense Commerce have been nearly cleared of all the obnoxious weeds that formerly choked its growth, and the agricultural industry of India will, under proper example and encouragement, keep pace with the never-ending improvements, which are from year to year progressing through the mechanical genius of our countrymen at home, which has so effectually changed the features of the Trade between England and India within the last twenty years."

He contemplates a prosperity for the future, which will make us forget the past.

The probability is, according to our intelligent author, that England will feel the necessity of drawing upon India for her supplies of sugar.

"And nothing has occurred in the political aspect of our West India Colonies, to shake this impression; on the contrary, the shipments during the last year, of nearly nine thousand maunds of Sugar from Calcutta to North America, is evidence of a deficiency somewhere; and it is obvious, that free labour in the West Indies, without taking into account, the immense sacrifice already made to rescue it from the stigma of slavery, can never be brought low enough to to compete with that of the Hindoo.

Upon what principle, then, is the discriminating duty on East India Sugar maintained? The people of England have been made to pay enormous sums, to indemnify the West India planter for the loss of his slaves, and in return for this boon, the people are compelled to purchase the produce of the East, at a much higher rate than that of the West, *because* England must maintain a strong military force to prevent the enfranchised negro from cutting his employer's throat.

This monstrous injustice will remedy itself at no distant period, if England continue long to bolster up the interests of one country at the expense of another. So long as an unnatural price for Sugar is maintained by means of unfair restrictions, the West India planter may endeavour to stem the current of competition from this country, but the odds are fearfully against a continuance even under the fostering patronage of protection, when it is considered that few estates are otherwise than deeply mortgaged, that the best lands are impoverished to an extent remediable only by importing manure from England, and that the amount of labor, to be purchased from a free negro, is far below the average of slave labor. The consequence of all these concurrent circumstances must be decreased production in the West, since in proportion to the enhanced cost of labor required to yield the same returns, as under slavery, it stands to reason that the Sugar must be sold at a higher rate, to give an adequate rate of interest on the capital employed.
This inconvenience to the West India planter will be felt more and more every year, unless he can replenish his estate with European laborers, and the climate is such as to place success in this respect out of the question, and he must ultimately abandon his estate. Not so, if free competition were allowed. The extent of shipments from India would give the West India planter timely warning to apply his remaining capital to some other channel of production, which could *not* be displaced by India. Unless some effort of this kind be made, it is clear, that the British West India Colonies will cease to export Sugar. They cannot compete with Foreign Colonies, where the trade in slavery is as rife, as when introduced by the Portuguese nearly four centuries ago; and unless England continue her restrictive duties on East India Sugar, an injustice that cannot be anticipated, she must necessarily look to India as the only source of supply.

Here then is a field for British skill and capital, if British skill and capital be not scared from application, of which unhappily there is some dread at present."

The foregoing is written in a language and spirit which are highly creditable to the author's feeling, whether we consider him in the character of a citizen, or, in the light of one warmly advocating the interests of this people and this country. He next shows the excessive amount of exports, in the past year, which has been made up of increase as follows, in round numbers.

"But to proceed with our present enquiry, —the excessive amount of Exports in the past year has been made up of increase as follows, in round numbers:—

On Opium,..	Sa. Rs.	68½ lakhs increase.
Indigo,..	„	47½ ditto.
Cotton,.....	„	27½ ditto.
Silk, ...	„	11½ ditto.
Saltpetre,...........	„	1¾ ditto.
Sugar,....	„	½ ditto.
Silk & mixedPc. Goods	„	3½ ditto
Lac Dye,............	„	1¼ ditto.
Shell Lac,...........	„	2½ ditto.
Hides and Skin,......	„	2 ditto.
Ginger,.............	„	¼ ditto.
Gunnies,....	„	⅛ ditto.
Linseed,...	„	⅛ ditto.
British Cotton Pc. Gds.,	„	1¾ ditto.
Ditto Woollens,.......	„	¼ ditto.
Coffee,..............	„	1¾ ditto.
		About 172¾ lakhs.

From this we are to deduct Decrease on grain and Flour Exported .... 17 lakhs.
Safflower,.. .... ½ ditto

About 17½ lakhs.

This would leave one crore and fifty-five and a half lakhs, in excess, while the latter gives only one crore and fifty-one lakhs; the difference between which and the former amount being made up of increase on sundries and other articles not enumerated in the above list, but which will be found under the head of "Exports General."

We now proceed to an analysis of the tonnage account, and it will be seen, that our former remarks on this subject are fully borne out by the results in the present year.

In the first place, a reference to the amount of Trade with each particular country or state, will show, that the whole augmentation in the Import Trade during the past year has been derived from British bottom, excepting about two lakhs, in excess from France: those who place reliance on tonnage figures, would therefore argue that the amount of tonnage must have proportionally increased.

Let us see how far this theory has been verified. In the face of an actual increase in the amount value of Merchandize imported in 1835-36, of 31 ½ lakhs of Rupees, we have an actual *decrease* in tonnage under the British flag, of 34,564 tons.

Again, under foreign colours, the amount compared with importing vessels in the previous year, exceeds it by 9,325 tons, equal to about 40 per cent of the whole foreign shipping, which, entered the Hooghly in 1835-36; to support which there is an increase on Imports of Merchandize from France, of something less than two lakhs of Rupees.

On the Export side we have a *deficiency* of tonnage under British bottoms of 29,511 tons, and an *excess* in the amount value of Merchandize shipped, of about one crore and seventeen lakhs of Rupees.

Under foreign colours the increase amounts to 9,953 tons, with an increase in merchandize Exported of thirty-four lakhs.

From these data, it is evident that the general prosperity of the trade of India can never be determined by a blind reliance on tonnage; but that, on the contrary, it is calculated to mislead both the merchant and political economist.

We admit that the greatest falling off in the Import list, attaches to the trade between Calcutta and Ports in Asia. Still the principle of non-reliance out to hold, good, when from America we find an excess in the numerical tonnage to the extent of 5,087 tons, and an increase in the amount value of merchandize of only about 7,000 Rupees.

We ought, however, to make some allowance for the quantity of tonnage occupied by *Ice*, the nominal value of which does not appear in the records of the Custom House, although the proceeds are re-invested in produce, and duly appear as a set-off against nothing.

The following tables will sufficiently elucidate what our readers may have failed to comprehend by a cursory perusal of the foregoing remarks.

COMPARATIVE ABSTRACT VIEW OF PRIVATE TRADE.
IMPORTS.

Countries.	1834-35. Merchandize.	Treasure	Total.	1835-36 Merchandize.	Treasure.	Total.	Result. Increase.	Decrease.
Gt. Britain,..	1,47,57,957	77,000	1,48,31,957	1,71 22,776½	4 500	1,71,27,276½	22,92,319½	..
France,..	7,69,255	2,00,637	9,69,892	9,43,769	24,879	9,68,648	..	1,244
Antwerp,.....	..	..	..	462	..	462	462	..
S America..	7,42,834	8,320	1,51,154	2,93,127	6,385½	2,99 512½	1,48,358½	..
N. America,..	3,02,160	5,51,577	8,53,737	3,09,799	12,93,454	16,03,253	7,49,516	..
C.of Cromdl,	5,46,154	1,00,988	6,47,142	4,71,928	80,269	5,52,197	..	94,945
Ceylon,....:	1 02'684	..	1,02,684	43 740	..	43 740	..	58,944
Mal-and Lac..	1,39,312	..	1,39,312	1 50 894	..	1,50 894	11,582	..
C.of Malabar..	13 78,714	5,500	13,84,214	23 21,192	..	23 21 192	9 36,978	..
A.& P Gulphs.	2 70,726	1,92,088	4,62,814	5 11,511	94,617½	6,06,128½	1,43,314½	..
Singapore, ...	11,01,831	12,30,615½	23,32 446½	6 00 117½	11,32,730	17,32,847½	..	5,99,599
Peng. & Mal.	3,60,894	1,12,400½	4,73,294½	5 69,265	1,02,699	6 71 964	1,98,666½	..
China,.......	11,42,136	32,94,383	44,36,519	5,90,936	32,92,803	38 83,739	..	5,52 780
N Holland,.	13,076	..	13,076	5,955		5,955		7,121
Sum.and Jav.	32,732	6 020	38 755	70,926	10,696½	81,922½	42,967½	..
Pegue,.......	2,06,193	6,54,715½	8,60,908½	3,94 925	6,11,206	10,06,131	1,45,222½	..
Mauritius,....	40,639	1,34,492	1,75,131	6,816	54,254	61,070	..	1,14,061
Bourbou,.. ..	1,05 302	..	1,05,302	1,37,491	2,76,189	4 13 680	3,08,378	..
Cape & S. Hl.	2,624	..	2,624	2,492	..	2,492	..	132
Total S. Rs.	2,14,15,226	65,68,736½	2,79,83,962½	2,45,48,122	69,84,682½	3,15,32,804½	49,77,668	14,28,826
				Deduct Decrease, ...			14,28,826	

Net Increase, in 1835-36..................... Sa. Rs. 35,48,842

or

Increase of Merchandize,............ 31,32,896

„ „ of Treasure,.................. 4,15,946

Sa Rs. 35,48,842

EXPORTS.

Countries.	1834-35. Merchandize.	Treasure.	Total.	1835 36. Merchandize.	Treasure.	Total.	Result. Increase.	Decrease.
Gt. Britain, .	1,47 56,781	52,262½	1,48,09,046½	1,90,74,653	13,655	1,90,88 308	42, 9.261½	..
France, ...	27,57 570	.	27,57,570	37,16,135	..	37,16,135	9,58,565	..
Denmark, ..	..	..	..	56,492	..	56,192	56,492	
N America, ..	15 72,111	..	15,72,111	39,69,902	..	39 69,902	23,97,791	..
Cormandel C. .	15,54,062	10,350	15.63,412	11, 7,720	1,88,427	13.45,947	..	2,28,465
Ceylon, ...	31,124	1,33,000	1,64,124	33,295	81 000	1,14.295	..	49,829
Mal. and Lac. .	53 075		53,075	71,622	.	71,622	18.547	..
C. of Malabar,	26.26,114	35 000	26,61 114	21 26,910	..	21,26.910	..	5,34,204
A & P. Gulphs,	9,42.317	..	9,42,317	13,64,505	..	13,64,505	4,22,188	..
Singapore, ...	19 51,117	13,375	19,64 392	19,15 003	..	19,15.093	..	49,366
Peng.& Malac,	3,69,889	..	3.69,889	6 03,808	..	6,08,808	2,38.919	..
China, ...	1,27,44,621	11,250	1,27,55.871	2,04,69,811	22 950	2 04.92,791	77,36,190	..
New Holland,.	2,01,265	36,452½	2,37,747½	1,94,879	8,164½	2 03,043½	..	34,704
Sum. and Java,	21,000	..	21,000	1,48,0·2		1,48 082	1,27,082	..
Pegue, ...	8,76,045	2,932½	8,78,977½	11.60,801	10 025	11,70.826	2,91,8,8½	
Mauritius, ...	11,61.094	1,35,563½	12 96,657½	6,27.121	62,970½	6,90.091½	.	6,06,566
Bourbon, ...	1,90 712	..	1,90,712	2,71,247	..	2.78.247	87,535	.
Cape&St. Hel.	70,75	..	70,751	36,689	..	36,689	..	33,062
Total, Sa. Rs.	4,18,79,681	4.30,183	4,23,09.867	5,70,00,765	3,86 992	5,73,87.757	1,66 15,11	15,37,229

Deduct Decrease,.... .... 15,37.229

Net Increase in 1835-36........ ... .Sa. Rs. 1,50,77,860

of

Increase of Merchandize,........ 1,51,21,081

Decrease of Treasure,................................ 43,194

Sa. Rs. 1,50,77,890

(To be continued.)

Art. VI.—Cursory notes on the Isle of France, made in 1827; with a map of the Island: by E. Stirling, Esq., *Member of the Asiatic Society,* 1833, *Calcutta.* Thacker & Co. *8vo. pp.* 50.

Continued from page 270.

Mr. Stirling proceeds to notice the improvements since the introduction of the English administration in the Isle of France. Attempts were made to improve the roads near the port, which have been attended with success. These improvements were undertaken on a system which has been little tried in wealthy India,—we mean the principle of Mr. MacAdam. Mr. Stirling says that there is no doubt that the scheme will render the most distant, as well as the most rugged part of the island, accessible for carriages and waggons. He states that the country is destitute of wells; but that, streams descend from the mountains and high lands; and suggests that the greatest benefit may be derived from conducting these waters to particular places. The town of Port Louis is therefore adorned with lively fountains, which afford an ample supply to the inhabitants, and, in many cases, the water is introduced into private houses. Nothing can be more true than that Mr. Stirling labours to impress upon the mind of his reader, that not only the health of the people, but the advancement of agriculture, manufactures, and commerce, in a tropical climate, depend on the economy used in the distribution of the waters. Mr. Bourdonnois, sensible of its importance, displayed much philanthropic exertion in conveying water to several places affording an agreeable supply at each *jet d'eau* of the clearest and sweetest water. What a splendid example! were it but followed in this City of Palaces, where nothing but filthy and abominable tank water is had, and even that in small quantities in most parts of Calcutta and its suburbs, how much sickness, bowel complaints especially, would be prevented!

" Formerly the water was brought by means of aqueducts from the " grand river," and the hill which overlooks the port, but now the town is also supplied from the side of Pamplemousses. This last work has been only lately effected; about a mile from the town, on the northern side, and near the road to Pamplemousses, is seen a very hand-

some aqueduct, supported by several arches, running across a small valley or low land. This aqueduct, it may be observed, appears to have been built of bricks; and although it has only been erected a short time, some accident had happened to it, and it was undergoing repair when I saw it. This deviation from the common practice in using bricks instead of stone, which is plentiful, does not, therefore, seem to have been successful, and it would appear very advisable to erect all such public works, in future, of stone, which is so much better adapted for permanent structures. This work is entirely due to the English administration, and more particularly, I believe, to the present Governor, Sir Henry Cole."

Our author states that the produce of the plantations is conveyed to the port at a very great expense by waggons and carts drawn by mules, bullocks, donkeys, and by boats. The carts are ill constructed and heavy, and the cattle yoked awkwardly. The coast vessels are numerous, and are from 30 to 40 tons. They bring produce from different parts of the island, as well as navigate between the islands of Rodriguez, Bourbon, and Seychelles. It appears, according to Mr. Stirling, that no attempts have been made to improve the harbours in different parts of the island: canals cannot be constructed in consequence of the nature of the country, which prevents such an undertaking. It is remarkable that there is no post established in the island; when a person wishes to communicate with his neighbours, or a more distant resident, he is compelled to hire a carrier. The barracks for King's Troops and Artillery at Port Louis, as well as at Magdeburgh, are represented as excellent. The principal public buildings consist of a well-built Roman Catholic and a Protestant church and a substantial Theatre. At a short distance from Port Louis are two strong fortifications in excellent order and repair: these command the entrance of the harbour. The Government House stands in a conspicuous situation, facing the quay: the Governor has a country house at Reduit, where he generally resides. The following remarks are worthy the notice of our commercial readers.

"The shipping of the Isle of France, the property of colonial inhabitants, is, I am led to suppose, small and insufficient, for the extent of the commercial transactions carried on. The island, therefore, depends very much on the good will of other ports, for furnishing it with a sufficient supply of vessels, both for the transportation of its new produce, and the importation of the necessaries of life—its superfluites and agricultural stock.

I conceive I am within bounds when I say, that there are not four thousand tons of shipping belonging to the port, exclusive of the small coast vessels before mentioned. The vessels that come from Calcutta, frequently bring rice, wish the expectation of receiving a cargo of sugar for England. Vessels from New South Wales and Van Dieman's Land, also bring coals with the same hope. English vessels find it often convenient to take out a few articles that are likely to meet with a ready sale at the Isle of France, on their way to India; and, in some few instances, ships are sent directly from London, and take back colonial produce in exchange for British manufacture. Some few ships arrive from the Cape with horses, and are either chartered to go to England with sugar, or return to the Cape with colonial produce. As the shipping of the Isle of France can scarcely be said to possess a distinctive character from English shipping in general, to attempt a description would be useless; and as the Act of Parliament which sanctioned the introduction of the sugars into England, has, I believe, provided for the footing on which its shipping should be received, a reference to it will shew the terms prescribed on the subject."

The Military force at the island consists of three King's regiments stationed on the island: they are changed periodically from home,—the relieved regiments proceeding either to England, New South Wales, or to our Indian presidencies. Two regiments are stationed at Port Louis and one at Magdeburgh, on the S. E. coast or the windward side of the island. Several posts are supplied with men from these corps,

"Which may be divided into external and internal commands. Under the former is Seychelles, Rodriguez, and Madagascar: the latter is, however not permanent, and may be considered as merely forming the escort of the Chargé d'Affaires. Under the latter may be classed Flac, Pierre Point, and the detachments at the Grand River, south-east, and Black River on the west coast. There is likewise a small guard on one of the small islands, at the entrance of the grand port, or south-eastern harbour. Besides these there are several guards that are furnished for various purposes, which it is unnecessary to specify, as most of them are daily relieved. I am unacquainted with the exact details of the detachment of artillery, but as they are superintended by an officer holding the rank of a Lieut.-Colonel, I suppose they are somewhat extensive. The strength of the whole force may be estimated at about eighteen hundred men. In addition to the officers attached to the several corps, there are many others who hold staff appointments in the colony, either on the general or personal staff of the Governor."

(To be continued).

Art. VII.—Results of an Enquiry respecting the Law of Mortality for British India, deduced from the Reports and Appendices of the Committee appointed by the Bengal Government in 1834, *to consider the expediency of a Government Life Assurance Institution. By* Captain H. B. Henderson, *Assistant*

Military Auditor General, Secretary to the Committee.—Transactions of the Asiatic Society, 1836.

(Continued from page 255.*)*

Capt. Henderson furnishes a table of the Calcutta burials, European and East Indian, at the Park Street burial-ground. He experienced some difficulty in ascertaining the births and periodical accession of strangers, and of separating the classes; he therefore found it impracticable to prepare from such data "an accurate or even approximating expectation of life for the city of Calcutta.

"It may be presumed that the accessions chiefly experienced, by arrivals from England, include between the ages of 18 and 25, and that thenceforward until the later ages of retirement and return to the native country, there is not much fluctuation in numbers, except in the yearly uncertain and temporary addition of seamen and commercial visitors. This, of course, applies to the European part of the community; the East Indian inhabitants being throughout more permanent and stationary. Under the foregoing supposition, it will be found from the numbers exhibited in the Table that out of a radix of population of both classes to the extent of near three thousand souls of the age of 20 to 25, about one hundred die annually, or, as the real decrement shew, 3.84 per cent. For the next ten years the annual percentage is 5.49. For the ensuing same term, or from 35 to 45 it is 6.7 per cent. From 45 to 55, it is 6.18, while from 55 to 65, (though this term is little to be relied on from the frequent secession of persons retiring to England) the percentage is 8.4. Out of four thousand, seven hundred and seventy-nine are seamen, who died on a visit to the port—swelling the ratio of decrement, it may be supposed, at the middle ages. It is to be regretted that this Table could not be rendered available for any useful purpose to the Committee: all that could be gathered from it was a picture of Indian mortality, probably in its concentrated, worst, and most appalling character."

Capt. Henderson does not think that the experience of the late life assurance institutions afforded data for guidance or a fair estimate of the ratio of decrement among the insuring classes, and proceeds to explain the difficulty and danger of relying upon the results of the different offices: these he ascribes to the insured being chiefly debtors in the service; men, it may be supposed, improvident in their life and habits: a few were adventurers, and others had embarked in speculations, who, however, were necessitated unwillingly to incur the expenses of life insurance;

"Or, as the figured Tables would sometimes lead to the suspicion, urged into the Society by the apprehension of approaching death. Thus, in the Fifth Laudable Society existing from 1822 to 1827 there were one hundred and eighty-seven lapses out of one thousand three hundred and ninety lives; no very considerable mortality it would appear at first sight, as it ranges under 3 per cent. per annum,—but on a closer inspection of the Table it will be seen that seventy-five of the one hundred and eighty-seven deaths occurred in the years immediately succeeding the Assurance, while the remainder of the lapses, one hundred and twelve in number, are traced to have lingered through ten years from the period of entrance into the Laudables. Such a misproportion of early lapses must have arisen from other causes than mere accident.

The Sixth Laudable Table in the possession of the Committee, gives only the total number of lives and lapses without classing them by years of entrance or decrement; the former were nine hundred and ninety-six in number, and the deaths one hundred and eighty, or 3.6 per cent. per annum—the common average; but by apportioning the presumed periods of lapses among the five years of the Laudable, the more correct yearly percentage would be exhibited at 3.8 9.

The Oriental has existed for a longer term, and has incurred engagements up to 1833, on so many as one thousand seven hundred and eighty-one lives; out of which during twelve years, it suffered to the extent of three hundred and seventy-three lapses. But unless, as will be understood by the more accurate and certain Tables to be hereafter referred to, there have been some extensive frauds at times practised on the Society, it is difficult to account for the very heavy rate of mortality it has experienced. It insured on an average seven hundred and eight lives yearly, losing of these with more or less regularity, more than thirty-one persons in the year, or an actual percentage of 4.39. Its greatest percentage of lapses during one year was 6.89, and its least 2.78. We believe here also some of the heaviest lapses occurred in certain cases shortly after the parties had effected insurance.

Although the Committee were unable to avail themselves of the experience of the Calcutta Life Insurance Offices to form a true estimate of the mortality, it may be remarked that the deaths exhibited by them never the less wonderfully bear out the fact shewn in all the general Tables prepared from the honorable company's different services of the *regularly progressive ratio of danger* (with a trifling exception only in some of the Tables,) *from increasing years and prolonged residence in India.* The ratio in the Army is generally under 3 per cent. for the first years of exposure, and increases to about $3\frac{1}{2}$ per cent. at 30: 4 per cent. at 40: more than $4\frac{1}{4}$ at 50, and considerably higher at the next decennial period, while shortly after this time

of life the longevity of the surviving Anglo-Indians almost keeps pace with the Northampton and other Tables, prepared during the last century in Europe. In the Civil Service the percentage of mortality for the last forty years has been somewhat under 2 per cent. for the first twenty years of residence in India; a result far more favorable than that of the other services. After the age of 40, the ratio of decrement would appear to keep pace with that of the Army.

At Bombay a Table has been received from England, prepared by an eminent Actuary on data furnished from that presidency, which would have been valuable, but that throughout the document the Actuary, in the absence of more correct data, has erroneously assumed, that the probability of living any one year up to the age of 58 is correctly expressed by the fraction $\frac{1}{18}$; or in other words, that from the age of 18 to 58, one person uniformly and regularly dies per annum from every twenty seven members of the service. This error, which it appears the Actuary had no means of rectifying, has vitiated the Table and calculations throughout, as it is at variance with the positive fact of the increasing danger of every five or ten years' residence in India. The progressive ratio of age holds good here as in Europe, with an increased impetus from the effect of climate. The result of this error has made the expectation of life in the Bombay Table nearly 20 per cent. too favourable for all ages above 30 or 35, diminishing the probable value of life for all ages below it. The fraction $\frac{1}{17}$, it is believed, may accurately represent the average annual decrement at Bombay for the entire service, but it varies necessarily with the age and rank of the individual, much in the same manner we presume as has been actually experienced in the last twenty years in the Bengal Army; where 2.34 per cent. has been the ratio of yearly mortality for Ensigns, 2.75 for Lieutenants, 3.45 for Captains, 4. 10 for Majors, 4.84 for Lieutenant-Colonels, and 5.94 for Colonels. We may assume the general ages of the Ensigns to have been under 22, the Lieutenants under 33, the Captains and Majors 45, the Lieutenant-Colonels 55, &c.

In the last twenty years (as recently ascertained) there have died one thousand one hundred and eighty-four Officers of the Bengal Army, or 59.2 per annum, out of an average number of one thousand eight hundred and ninety-seven persons, or about 3.12 per cent; the mean ages of the deceased were as follows:—

81 Colonels, deceased, mean age,.....61
97 Lieut.-Cols. ditto, ditto,.........51
78 Majors, ditto, ditto,.........40
277 Captains, ditto, ditto,.........36
651 Subalterns, the mean age not ascertained, but it ranged from 18 to 33.

It may be as well here to exhibit in a simple comparative Table the difference of the rate of mortality at the three Presidencies, Bengal being clearly less inimical to the health of the European than either Madras or Bombay.

*Comparative annual percentage of Mortality of the Officers of the three Armies of Bengal, Madras and Bombay.**

PRESIDENCY.	*Colonels.*	*Lieut.-Colonels.*	*Majors.*	*Captains.*	*Lieutenants.*	*Cornets and Ensigns.*	*Surgeons.*	*Assist. Surgeons.*	*Total or General Percentage.*	GENERAL AVERAGE.
Bengal,	5.94	4.84	4.10	3.45	2.75	2.34	—	—	3.12	3.85
Madras,	5.40	6.11	5.42	5.02	4.17	3.80	4.68	4.31	4.49	
Bombay,	5.74	5 45	3.77	3.78	3.96	3.15	4.08	4.21	3.94	

The rate of mortality in the Bengal Pilot Service has been accurately registered for the past thirty years. Its numbers are not sufficient for any general Table, as the annual effective strength of the Department has averaged only about one hundred and forty individuals. Out of these have demised 3.36 per cent. while as many as 31 more, (or 0.73 per cent.) have been drowned; this mode of death having occasioned nearly one-sixth of the entire mortality. On the examination of the Tables of the Pilot Establishment which have been compiled in the Master Attendant's Office, under orders of the Marine Board, several curious circumstances have come to view. Presuming them to be correct, we find their rate of decrement, generally speaking, does not exceed that of the Officers of the Army, but the periods of service and the ages of the deceased are much less than those of the Europeans elsewhere exhibited. Thus while the Branch Pilots or seniors, whose time of life corresponds with that of Field Officers, have demised at the percentage of 4.46 per annum, the extreme age of the oldest has been 47 only, the mean age being 44 of all who died.

The oldest Pilot on the list had only served thirty years, the mean of servitude for the whole casualties being only twenty-three years. Thirty-two Masters have died in thirty years, the percentage being 4.30, their mean age at the time of death being thirty-six, after a mean of service of seventeen years. The deaths in the First Mates (the most exposed class probably) have been heaviest of any, or 5 per cent.: their mean age was 28, and their period of service ten years. The Second Mates deceased only at half that rate, their mean age being 28 also, their service eight years. Among the Volunteers, the casualties by drowning are twenty, while the natural deaths are only fifty, the total percentage per annum being 4.10, the mean age of the deceased of this rank was 22, and their average periods of service three and a half years."

To be continued.

ORIGINAL COMMUNICATIONS.

ON SOME NEW SPECIES OF THE EDOLIAN AND CEBLEPŸRINE SUB-FAMILIES OF THE LANIIDÆ OF NEPAL.

By B. H. Hodgson, Esq.,
Resident in Nepal.

(For the India Review.)

The dark-coloured shrikes of India, if they are, most of them, not wholly unknown to science, yet seem all very imperfectly known; whence has resulted the customary confusion of species and unsatisfactory classification. Hereafter, with more ample knowledge of their manners, and the aid of European libraries and museums, I trust to be able to dispose these birds in a natural manner. But I shall at present confine myself merely to a few indications on that subject, limiting this paper chiefly to an attempt to fix some of the species beyond the possibility of future doubts.

EDOLIANÆ.

Genus edolius? Genus? Subgenus? Chibia nobis. Bhring-raj * of the Hindoos. Chibya of the mountaineers (genericè).

1st Species, new. Casia nobis (Késya, quasi comatus, of Nepal).

Form and size, 13 inches long by 20 in expanse of wings; bill $1\frac{10}{18}$ tail 6; tarsus $1\frac{7}{16}$ central toe $\frac{12}{16}$; hind $\frac{10}{16}$; weight $3\frac{1}{2}$ oz. Bill, a third longer than the head, conspicuously and uniformly arched throughout, not hooked, nor depressed, at base as high as broad, and much compressed forwards; general form, subtetragonal, with sharp ridges and nearly plane somewhat spreading sides, especially those of the maxilla in its basal half; for in its anteal half the sides become nearly vertical by extreme compression: tomiæ very trenchant and remote from the ridged palate, those of the lower mandible fitting into a groove just within those of the upper: the tips acute and subequal; having the curve and recurve; the tooth and notch all distinct, though very small, especially the latter. Nasal fossæ short but distinctly keeling the culmen between them, provided with membranes, and hid by thick-set velvety plumes very moderately produced over the bill and putting forth several long flowing elastic hairs which sweep with a fine curve over the head and neck.

Rictus to the eye and strongly bristled. Nares basal, lateral, ovoid, shaded above by a small process of the fossal membrane and hid by velvety plumes and adpressed rigid hairs. Tongue nearly equal to the bill, deeply cleft and feathered. Cervical plumes elongated, narrow, pointed, and curved gracefully backwards. Tail shorter than the body, consisting of ten, strong, and nearly even plumes, the two externals only possessing palpably the divaricating structure, and, being produced about $\frac{3}{4}$ an inch beyond the next, have their tips curled boldly over them. Wings ample, reaching to the middle and more of the tail, or two and half inches short of its tip: alar quills broad-webbed and obtusely pointed, even in the primaries which exceed the tertiaries by only $1\frac{3}{4}$ inches. Closed wing $6\frac{1}{2}$; where of the 1st quill is $3\frac{1}{2}$; the 2nd $5\frac{1}{4}$; the 3rd $6\frac{1}{4}$; the 4th $6\frac{3}{8}$; and the 5th and longest, $6\frac{1}{2}$.

Legs and feet strong. Tarsus considerably longer than any of the digits and heavily scaled. Toes stout, short, unequal; the fores basally connected; the outer, beyond the joint; the inner, less; their soles full but subdepressed: the hind toe, large, depressed, and equal to the outer fore one. Nails, strong, falcate, and rather acute; the hind one largest. Intestines, 15 inches long, larg-

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* Note, Bhring-Raja, quasi Rexa pum. is. in the plains, the generic name of our 3 first species. Chibia is the hill name. As I have separated the 3rd species subgenerically, I have applied the latter name to the two first species, and the former, to the third. Bhringa, Bhringaca, and Bhring-raj, are synonimes, most improperly applied by Wilson to Lanius carulescens and other *Bhuchangas*. Quoad the use of native generic appellations, I think there is wisdom in it, as helping the student in India to discover affinities which the people have ascertained from long familiarity. And, with respect to the European student, what can he rationally object? A single word or dinarity *cannot* pourtray a group or genus: and are not half Cuviers generic terms derived from Greek or Latin names o 1 *unknown* birds? Indian words are generally as euphonous as the cognate Greek and Latin ones, and, I may add, as signiycant too. I have serious thoughts of a classification founded in the results of native experience, or, in other words, upon the adoption of Indian generic terms. The great difficulty is to ascertain the *value* of those terms; but, once ascertained, they will often serve as a better guide to affinities than all the science of Europe, wasted, as it is, upon dried skins! Europeans in India have done all they could to confuse native nomenclature by limiting to species the generic terms of the people: witness Haran, Mriga, Bagjarceta, Dhanesa, &c. &c.

er above than below. Cœca $\frac{5}{8}$ of an inch. Stomach muscular and red; outer coat of medial unequal thickness; inner, tough and striolated. Food, chiefly wasps, bees, and their congeners, also green beetles, and other coleoptera; very rarely vetches. Solitary or in pairs, part of the year in families the young with the parents, never quits the forests; descends from time to time from its lofty perch to seize on the wing, occasionally seizes on the ground, but instantly returns to its perch. Common to all the three regions of Nepal. Moults in autumn between August and October, and, I think, only in autumn.

Colour, black, most brilliantly burnished with metallic green on the alar and caudal plumes, as well as on the elongate cervical ones; but intense purplish blue, for the most part, on the body, the lores, and ears, unpolished black: the wing and tail, internally, glossy black, without accessory hue: bill, dusky: legs, jetty: iris, brown. Sexes alike both in size and colours: the lining of the wings, in male and female, apt to be spotted with white; as I think only in summer, and the mark seems generic.

2nd Species, new Malabaroïdes nobis. Calgia (quasi cristatus) of Nepal.

Form and size Tip of bill to tip of ordinary tail 15 inches, where of the bill is $1\frac{10}{16}$ and the tail 7. Appendage of the latter, 8 more. Tarsus $1\frac{4}{16}$; central toe $\frac{13}{16}$; hind $\frac{11}{16}$; weight $3\frac{1}{2}$ oz. The external and internal characters, like the habits and manners, of this species are, in general, strictly similar to those of the precedent. We shall distinguish wherever there is room for it. The bill, equally long in proportion to the head, is noticeably straighter, less compressed forwards and rather more keeled and plumed at the base; its mandibles are less equal, less acute, and they have the terminal curve and recurve, tooth and notch, more distinct. The general form of the bill is distinctly tetragonal, the mere tip only being compressed. But there is, as before, as much height as breadth at the base, and the bill is no where depressed. The more advanced nares are, however, much nearer to the gape than to the tip. They are shaped, membraned, and plumore, as before; but their plumes are of a different character. The close velvety short capistral feathers of casia are replaced by long setaceous and erect ones shooting upwards and forwards far beyond the culmen; whilst the graceful comate crest of casia is supplied by hardy less graceful plumose one, consisting of narrow, composed, erect, and recurved plumes inserted laterally and oppositely on each side the base of the bill. These hairs in casia are $4\frac{1}{2}$ inches long, and consequently fall over the shoulders. The analogous plumes in malabaroïdes are but two inches long; and, being firm and erect at their insertion, are restricted to the crown of the head, over which they make a bold and elegant curve. The tongue is rather shorter and somewhat less feathered. The legs and feet and wings are identical in both. The tail has the same proportion to the body and the same number of plumes; but these plumes in malabaroïdes are palpably forked, the centrals being $\frac{3}{4}$ of an inch shorter than the laterals; excluding, of course, the oar-shaped *appendages* of the tail. The latter are scarcely more than as long again as the true tail; at their separation from which the shafts become denuded of webs until $3\frac{1}{2}$ inches from the ends, that space being occupied by a broad paddle-like vane restricted to the *inner* side, though constantly reverted (by curvation) to the outer.

Colour. Bill and legs bothjetty, and iris dark brown. Plumage uniform black, burnished as in the precedent but rather less highly. Head and neck plumes, especially the latter, similarly elongated and lanceolate. Setaceous feathers of the lores, chin, and ears, unglossed. Sexes alike in all respects; and both apt to have the lining of the wings white-spotted.

Remark.—Amid the imperfect, and, in some respects, contradictory indications of books, I discern the evident affinity of this species with malabaricus vel retifer. I have therefore called it malabaroïdes. Is frequently caged for its song; and, if let loose in a house, will eagerly catch and devour the small lizards so common in Bengal residencies.

Sub genus Bhringa nobis.

3rd Species, new. Tectirostris nobis.

Size and form, 11 inches long by 16 wide, and $2\frac{1}{4}$ oz. in weight. Bill $1\frac{2}{16}$; tail $5\frac{3}{4}$; appendage of tail 12; tarsus $\frac{15}{16}$; central toe $\frac{9}{16}$, hind $\frac{8}{16}$. This species, to the habits and manners of the two precedent, unites a plumage and a general structure also similar to theirs, with the material exception of the bill, which both in form and proportion deviates from the rostrum of the two last to approximate to the familiar species hereafter described. It is as nearly allied to Temmincks remifer as its predecessor is to malabaricus. Bill scarcely a fourth longer than the head, strong, straight, but with the raised acute culmen arched from the nares not hooked;* tetragonal, at base broader than high, and a good deal spread except near the tip, where it is extremely compressed. Curve and recurve, tooth and notch, all rather prominent. Upper mandible half keeled, and nearly hid by setaceous incumbent plumes (unde nomen). Nostrils midway to the tip from the gape, small, round, subvertically exposed, without membranous tect, and hid by the plumes just mentioned, behind which, the thick set, soft, composed and simple feathers of the forehead rise, helping, with the former, to con-

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* Note.—The true hook or falconine process of the maxilla is confined to the typical shrikes. The Bush shrikes have it in a feebler form. The Edolian and Ceblepyrine shrikes want it almost wholly. This is the general rule: but, as we shall see, the hook is distinctly developed in our Bhuchangas.

ceal the bill. Rictus to eye, and strongly bristled, below as well as above.

Plumes of the head and neck, lanceolate; and those of the neck also elongated and burnished as in the two precedent species. Legs, and feet, and wings, as in them; but the tarsi and toes somewhat slenderer, and the thumb perhaps rather more developed. Ordinary tail shorter than the body, and composed of ten even plumes: its appendages more than double its length; nude-shafted as in malabaroïdes, with 3 and $\frac{1}{2}$ inches of the tips barbed, and equally so on both sides of the shafts. Is a shy and retired forester, like the two last, feeding like them on the wing, by occasional darts from its lofty perch. Food, wasps, bees, various small coleoptera, with grilli, mantides, and other flying insects. *Colour*, black, with a very brilliant blue changing sometimes intō green: belly and gloss, flanks, slaty black and unglossed, especially in the female, which is rather less in size than her mate, but otherwise similar. Lining of the wings usually spotted with pure white both sexes: bill and legs, jetty: iris, dark in brown.

Subgenus Bhûchanga nobis.

4th Species. Indicus necnon Fingah auctorum? Albirictus or spotted gape nobis. Described by me, some years ago, in the Asiatic Society's Transactions. Distinguishable from all the precedent, by its familiarity with man,. by its simple plumage, by its parabolic evolutions in the air, by the superior length and power of its wings, its deeply forked tail, its shorter and unfeathered tongue, its feebler thumb, its more or less conical bill, and its non-apivorous habits. In the strength of its legs and feet it more nearly resemble casia and malabaroïdes than tectirostris; but, in the form and size of its bill, is it much liker to the latter than to the former.

Structure and size, $12\frac{1}{2}$ inches long by $18\frac{1}{2}$ between the wings. Bill $1\frac{1}{16}$; tail $6\frac{3}{4}$; tarsus $\frac{15}{16}$; central toe $\frac{10}{16}$. hind $\frac{7}{16}$. Weight $2\frac{1}{4}$ oz. Bill scarcely longer than the head, strong, straight, hooked, conico-tetragonal, with blunt ridges and subconvexed sides, at base broader than high, and considerably spread except towards the tip which is compressed, but less so than in the last. Curve and recurve, tooth and notch, all prominent. Culmen scarcely $\frac{1}{3}$ keeled, and only so far hid by the thick-set soft frontal plumes which end in adpressed setæ and hairs over the nares. The nostrils are a good deal advanced, but nearer to the gape than the tip. They are small, round, lateral, shaded above by a small process of the fossal membrane, and closely pressed by the nareal tufts. Rictus to eye and strongly bristled. Tongue shortish, subbifid, and subjagged; *not* feathered like the foregone species.

Plumage simple and but faintly glossed. Wings long, strong, and acuminate, reaching beyond the middle of the long tail; $2\frac{3}{4}$ inches less its tip. Closed wings 6 inches, whereof the 1st quill is 3; the 2nd 5; the 3rd and 5th, $5\frac{3}{4}$; the 4th and longest 6; primes plus tertials $1\frac{3}{4}$ inch, and harder and more pointed than in any of the precedent. Tail 10, longer than the body and deeply forked, the centrals being $2\frac{1}{2}$ inches less the extreme laterals; legs and feet strong and heavily scaled; tarsus longer than any toe; toes short, unequal; the fores rather full-soled, and basally connected, but less than in any of the foregone; thumb, strong and depressed, though not elongated, equal only to the inner fore toe; nails very acute, the hind largest, as in the others.

Colour, black, with a dark blue gloss changing to green and prevailing throughout. Alar plumes internally with a greyish hue and not glossed; caudal, black and glossy below. Bill and legs jetty: iris, red brown: lores, black: behind the gape a permanent pure white spot (unde nomen). Female, less: her belly and flanks shaded with white; and her wing-lining under tail-coverts maculate with the same. Young and moulting birds, very similar to the female, but wanting the rictal spot which the grown females in full plumage has, as well as the male.

5th Species, new? Fingah? Æratus? auctorum. Annectans nobis. Annectant Bhuchanga nobis. A singular species, returning, both by its form and habits, towards the forest,—haunting birds first described, through the 3rd or Tectirostris, which it very closely resembles in the form of its bill.

Structure and size, $11\frac{1}{2}$ inches long by 17 in expanse of wings, and 2 oz. in weight; bill $1\frac{2}{16}$. tail $5\frac{1}{4}$; tarsus $\frac{15}{16}$, central toe $\frac{10}{16}$. hind $\frac{7}{16}$. The strong wing with the 4th quill longest, the distinctly forked tail, the simple tongue, the moderately elongated distinctly hooked bill, the shortish thumb, and simple plumage, proclaim this bird a bhuchanga, or, in other words, attest its intimate affinity with the last or albirictus. Indeed, any ordinary observer would confound the two, as those who ought to have studied closer have done in costly tomes of natural history. Yet a broader, more angular, less straight, and less hooked bill, together with a shorter tail, far less forked, sufficiently prove the specific distinctness; notwithstanding an uniformity of colouring in both sexes of the two species amounting almost to identity. Bill, distinctly longer than the head, subarcuate, strong, spreading, but not depressed; slightly hooked, tetragonal with sharp ridges, and nearly plane sides, gradually and moderately compressed towards the tip. Nares, gape, and capistrum, as in the last. Wings scarcely so strong. Tail shorter than the body, and forked barely one inch.

Colour, lack with a moderate changeable blue or green gloss: no spot behind the gape. The female and young have the breast, lining of wings, and lower tail coverts spotted or shaded with white: bill and legs jetty: iris red brown. Rarer and less familiar than albiricus, but not a forester.

Sub-genus Chaptia nobis. Chaptya (quasi Platyrynchus) of Nepal.

6th Species. Muscipetoides nobis. Remarkable for the feebleness of its bill and feet, and seeming absolutely to unite the laniidæ and musci capidæ. It might be classed, indifferently, with either. The bill and feet are quite those of muscipeta; but there is in both that additional degree of strength which, added to the blue-glossed black plumage with lanceolate hackles, and to the ten-feathered forked tail, affines our bird to the Edolian shrikes. Cuvier, I am aware, classed the Edolianæ with the fly-catchers: but they have have since, with reason, been associated with the Laniidæ or shrikes.

Structure and size, $9\frac{3}{4}$ inches by $14\frac{1}{2}$: 1 oz. or less in weight. Bill $\frac{15}{16}$; tail 5 Tarsus $\frac{10}{16}$. Central toe $\frac{7}{16}$ hind $\frac{4}{16}$. Bill rather longer than the head, feeble, depressed with sharp ridges and plane spreading sides, scarcely compressed at the mere tip of the bill, straight with the culmen very slightly inclined from the nares; upper mandible distinctly longer and subhooked. Tooth, notch, and recurve, all palpable but feeble. Culmen, $\frac{1}{3}$ keeled and so far hid by incumbent and procumbent setaceous plumes ending in hairs over the nostrils. Nostrils elliptic, large, longitudinal, forward but nearer the gape than the tip, lateral, shaded above by a largish process of the fossal membrane and closely hid by incumbent setæ. Rictus to eye and *very* strongly bristled above and below. Tongue short, flat, cartilaginous, subbifid, and subjagged, not feathered. Wings long and acuminate, reaching to middle of long tail, and $2\frac{1}{2}$ inches less its tip: 1st quill very small; 2nd long; 4th clearly longest, and $1\frac{1}{2}$ inch plus tertials. Tail longer than the body, and forked more than one inch, that is, rather deeply. Tarsi rather feeble, as compared with any of the precedent, but the acrotarsia strongly scaled, as usual. Toes short, depressed, slender; the fores much connected; the outer $\frac{1}{2}$ way beyond the joint, and the inner $\frac{1}{2}$ way to it. Outer and central subequal; inner, much shorter; hind, least, sometimes equal to inner fore. Claws, strong and very acute. Plumage of the head and neck distinguished by the intense gloss and lanceolate form, already noticed in regard to the three first described species; and lining of the wings, similarly spotted with pure white.

Colour, black, with an intense blue gloss, strongest on the head, neck, and wings. Alar and caudal plumes, jetty and shining on their inferior surface; lower belly and flanks, frequently unglossed and scarcely full black, especially in the females and young; bill and legs, jet black; iris, dusky brown. Sexes alike. Shy, adhering to the forests; feeds chiefly on the softer flying insects which it takes on the wing exclusively, but not by continued questing; has an autumnal moult between August and October, and I think but one per annum. Intestines 8 to 10 inches long, thicker above, and provided with tiny cæca. Stomach, muscular and red; its lining, toughishand nearly smooth.

CEBLEPYRINÆ.

Genus Grauculus Cuvier.

7th Species, new. Nipalensis nobis.

Form and size, $13\frac{1}{2}$ inches long by 22 in expanse of wings: bill $1\frac{1}{2}$; tail 6. Tarsus $1\frac{4}{16}$. central toe $\frac{15}{16}$. hind $\frac{6}{16}$, A closed wing 7 inches whereof the 1st buill is $4\frac{1}{4}$, the 2nd $6\frac{3}{8}$, the 3rd and 5th $6\frac{7}{8}$, and the 4th and longest 7. Weight 5 oz.

Bill, a fifth or sixth longer than the head, strong, spreading, and much broader than high at the base; but still not strictly depressed, subarcuate throughout: upper mandible, bent with an acute elevate ridge and sloping sides nearly void of convexity; lower mandible, obtusely round, except near the tip; curve and recurve, tooth and notch, all palpable. but moderate. Frontal feathers, far produced over the bill, and soft, with a narrow margin of subsetaceous plumes, the foremost of which are laid over the nares, where they end in adpressed hairs; not more than a fourth of the culmen keeled. Tomiæ very trenchant, deeply locked, and remote from the scooped and ridged palate. Rictus prolonged beneath the eye and distinctly though very feebly bristled. Nares much advanced and nearer to the tip than to the gape, small, round, sunk, lateral, shaded above by a small process of the fossal membrane, and closely hid by adpressed setæ and hairs. Wings medial, strong, and acuminate, reaching to middle of tail and more; primes plus tertials, $1\frac{3}{4}$ inches. Tail as long as the body, consisting of 12 firm, straight feathers; whereof the 4 laterals are slightly gradated from below, but scarcely $\frac{1}{2}$ an inch in the extremes. Legs and feet rather short and feeble in relation to the size of the bird; tarsi considerably higher than any toe, and heavily scaled to the front and sides; smooth and sharp behind, like all the foregone. Toes shortish, unequal, subdepressed; the fores distinctly connected on the superior surface, but nearly cleft below. Thumb short, but broad and strong. Claws strong, curved, and rather acute. Plumage, in general, soft and discomposed, but that of the rump, spinous. Tongue short, flat, cartilaginous, with acute subbifi tip. Intestines 14 to 15 inches long, thicker above, and furnished with two tiny cæca close to the anal end. Stomach muscular and red. Outer coat of considerable unequal thickness; inner, leathery andgrooved. Food, grilli, mantides scarabæi, berries, vetches, and seeds. Solitary for the most part, and adhering to the forests; but sometimes approaching gardens and orchards. Feeds on the ground as well as on the wing, and has a shrill voice, exactly like that of the halcyons. To an extremely corvine aspect this bird adds something of the manners and habits of the corvidæ, entitling it, at least, to generic separation from ceblepyris, though its true place be, no doubt, amongst the ceblepyrinæ.

Colour; full slaty grey-blue, with black wings and tail, and pure white belly, vent, and under tail coverts. Lores, narrow frontal band, mere base of bill, and the chin, con-

fluently black. Alar and caudal plumes, with the lining of the wings, albescent on the inferior aspect: two central tail feathers almost wholly concolorous with the body; the rest black, with clear broad whitish tips: the tertial wing feathers wholly, and the edges of most of the rest, slaty like the body: bill and legs, jet black: iris, dark brown. The female, equal in size to her mate, is paler on the inferior surface of the neck and body, where, as well as on the lining of the wings, the slaty hue is transversely lineated on a whitish ground: the edging of her alar plumes also is whitish; and she wants, nearly or wholly, the black zone surrounding the entire base of the bill in the male. The young males, for a whole year, resemble her.

Ceblepyrinæ.

Erucivora? Sw. Volvocivora nobis.

8th Species. New and type. Melaschistos nobis. This singular bird indicates its affinity with the last named by its slaty and black garb, transversely lineated below, in the female; as well as by its puffy and spinous rump feathers, the rest of the plumage being unglossed, soft, and discomposed. The wings, tail, and feet, too, are not materially dissimilar, though the bill is. The wings, however, are obviously feebler, and, being so, are naturally accompanied by a longer and distinctly wedged tail. But the almost purely conical and wholly undepressed bill seems to defy whatever has yet been predicated of the sub-family!

In the whole structure there is an evident approach to Malaconotus and Phœnicornis.

Size and from. Bill scarcely longer than the head, very moderate in all respects, elongately conical, culmen straight and concealed as far as the nares, very slightly inclined and apert beyond them. Nostrils central, small, oval, lateral, membranously edged above, and hid by semi-setaceous curling plumuli and hairs. Rictus moderate, subciliated. Nape with a few feeble hairs hardly escaping from the plumage. Wings moderate, round, acuminate; 4th quill longest, gradated as in grauculus. Tail as long as the body, or longer, consisting of 12 feathers; whereof the 6 central are even, and the 6 lateral, considerably gradated, to $1\frac{1}{4}$ inch in the extremes; the whole, firm and broad tipped. Tarsi sub-clevate, moderately stout, rather finely scaled. Toes not short, rather slender; fores somewhat compressed and basally connected; central, sub-elongate; hind, short but broad and depressed. Nails subacute. $9\frac{3}{4}$ inches long by 14 wide, and $1\frac{1}{2}$ oz. bill 1; tail 5; tarsus 1; central toe $\frac{10}{16}$. hind $\frac{6}{16}$. closed wing $4\frac{3}{4}$; whereof 1st quill is $2\frac{3}{4}$, 2nd $4\frac{1}{4}$, 3rd and 5th $4\frac{5}{8}$. and 4th and longest, $4\frac{6}{8}$. tertials $1\frac{1}{4}$ less the primes.

Colour, blackish slaty, with jet black wings, tail, and lores; the 6 or 8 lateral rectrices with broad white points. Legs, dusky slaty: bill black: iris, brown. Female rather less, paler below, and transversely rayed throughout with a more saturate series of zigzags. She has, also, a white spot, internal and basal, occupying 3 or 4 of her prime quills; and her lores are not blackened. The young of a year resemble the female. They have, at first, whitish drops on a purplish black mantle. The species is confined to the woods, and is solitary or nearly so. The intestines are 10 to 11 inches long, of nearly equal calibre throughout, and having the cæca hardly traceable. The stomach is muscular and red, with an outer coat of medial unequal thickness, and a tough lining. The principal food is caterpillars and other soft wingless insects; but many soft and hard flying insects are likewise taken, with grubs, larvæ, and insect eggs, and frequently stony berries and even seeds. These birds, though they procure the greatest portion of their food on trees, yet freely descend to the ground to gather it there also.

Our birds, in the structure of the bill, appear to be allied to Mr. Swainson's Erucivora; but they have the croup puffy and spinous, like the majority of their confamiliars. I have procured abundance of specimens from all parts of the hills, and at all seasons of the year, the species (like all those previously described) not being migratory.

General Remarks.

Cuvier observes of the Edolianœ that they are principally distinguished by the two mandibles being bent the whole length. This is a character distinctly marked in our 3 first species, but wanting in the 3 next; seen again, in the 7th and absent in the 8th. Cuvier adds that the Edolian bill is depressed; a feature not strictly belonging to any of our species save the 6th. Mr. Swainson says that the Edolianæ are characterised by a bill broad at the base and compressed on the sides. This, with some allowance, holds true of our 5 first species, and also of the 7th, if breadth at the base be not confounded with depression. Mr. Swainson further observes that "in every species yet discovered the hind toe is so much developed as to exceed the tarsus, being little shorter than the middle toe".

Now, in all my species, the tarsus is longer than the central digit, which again exceeds the thumb in length. I measure the tarsus, on the inner side, from its more salient angle down to the sole of the foot; and the digits from their strict insertion, superiorly, to the commencement of the claw. So measured, there is not one of the foregoing 8 species, in which the tarsus does not exceed any of the digits, or, in which the middle finger does not surpass the thumb; though the superior size of the thumb in the 3 first species, as compared with the other 5, is very noticeable. In the former, this member is equal to the *outer* fore digit; whilst in the latter it is equal only to the *inner* fore, or less. Strong rictal bristles characterise the whole of the 6 first species which I have classed with the Edolianæ; and the 6th agrees with the 3 first in possessing, on the neck, at least ornamental feathers, as well as a highly-burnished general plumage. But the bhuchangas want both these marks; and, in the two species of them, the hook and tooth of the bill, by their superior development, indicate a leaning towards the lanianæ. In all our

8 species, the tip of the lower mandible is sensibly bent up and notched despite the dictum of the systematist.

Nor is gregariousness the characterstic of the manners of any of them, tho' the young attend their parents for several months.

The structure of the wing is similar in the 3 first species. The two next also have a common form, but differing from the precedent. A third change takes place in the 6th. The first differs from the two next by its velvety capistral plumes, which, however, are accompanied by strong nareal and rictal bristles.

In passing from the Edolianœ to the Ceblepyrinæ Mr. Swainson observes that the latter are characterised by "greater depression and consequent weakness of the bill." I have classed our two last species with the Ceblepyrinœ because of their smooth gape, their puffy and spinous rump feathers, their unburnished and unblackened plumage, their less exclusively perching legs and feet, and their more onnivorous habits. But, the very opposite of depression is the character of the bill in one of them; whilst the other has great breadth, indeed, in the rostrum, but without feebleness or depression. These latter are properly the characters of our 6th species only; which, however, is very clearly *not* a Ceblepyris. Much as I admire the skilful labors of Mr. Swainson, I cannot think so highly of my luck in the discovery of rarities, or so lowly of my discernment in the appreciation of ordinary forms, as not to suspect that those labours call for yet further revision. The Ceblepyrinœ are obviouly less formed for flight and raption than the Edolianœ, and their ungarnished vestments are equally contradistinctive.

A forked tail of ten feathers seems as prevalent among the Edolianœ as a wedged one of twelve amongst the Ceblepyrinœ—one of several indications tending to demonstrate the superior power of the former upon the wing.

Lastly, all of our Edolianœ have a fine voice, whilst the Ceblepyrinœ seem to be silent or worse: Heaven defend our ears from the clamorous screaming of Grauculus.

Valley of Nepal, 1836.

DESCRIPTION OF A SPECIES OF ICHNUEMON, INHABITING THE INTERIOR OF THE GALL BY AN INSECT ON THE LEAVES OF THE FICUS RACEMOSA.

By P. F. H. Baddeley, Esq.

For the India Review.

In my examination of the interior of the gall formed by an insect already described, I frequently observed a small light coloured grub, which I at first imagined might live and feed at the expense of the natural inhabitant: I have, however, since ascertained that such is not the case, but that both live independently, and feed upon the vegetable juices without detriment to each other.

This insect is so often found to occupy the interior of the gall, that many might conclude that it was the very insect that produced the excresence, and would consequently be led to form opinions, regarding its nature, totally at variance with the truth.

In the description of this insect a striking contrast will be observed to exist between its internal economy and that of the real gall insect; for in the former all the essential charactaristics both of the several states of the imperfect, as well as the structure of the perfect insect, will be found to agree exactly with the definition of the hymenopterous order; while those of the latter scarcely tally with it in one point.

This circumstance may tend to confirm the opinion, expressed on a former occasion, that if the gall insect be a *cynips*, it must be referred to a class, different from that under which that Tribe is usually described.

The produce of this grub is a 4 winged insect, of the ichneumon genus, the female of which is armed with a long ovipositor, which she introduces (I presume) into the interior of the gall, (from its under surface) formed on the leaves of the ficus racemosa, about the period that the gall insect has become enclosed in this excrescence, and these deposit on the body of the pupa, a single egg. This shortly changes to a larva or grub, invisible to the unassisted eye, which still continues attached to the body of the gall insect, and lives and grows for a certain time at its expense.

With a change of skin however the pupa rids itself of this rarusitic appendage, which now becomes endued with different tastes and acquires herbivirous habits, feeding in concert, on the juices of the interior of the gall.

In this occupation it continues to grow, without detriment to the other inmate, and about the time that the gall insect is ready to emerge, this grub has attained its full growth, and commences to form its cocoon, for the purpose of undergoing its transformation to a chrysalis.

This, when completed, occupies about one third of the cavity of the gall, to the side of which it is closely adherent.

It is of an ovate shape, flattened on the free surface and pointed at one extremity,

and is thin, transparent, and of a very compact texture, having a narrow bright yellow band, surrounding its longer circumference.

In this web, the chrysalis, which is white, is seen to repose, with its head invariably directed towards the point at which the gall insect intends to escape; and in a few days gradually to assume the appearance of the perfect insect.

We may now observe the several parts as they lie doubled up in this confinement.

The antennæ, which are remarkable for their length, are seen lying along the back and the ovipositor is turned in a contrary direction, on the belly.

Not many days after the gall insect has made its escape, this insect, having attained its perfect form, breaks through its covering, and squeezing itself through the same aperture, by which the former insect had previously made its exit, emerges at once a perfect fly, the wings and other parts having attained their full size whilst in the cocoon.

Little difference is observable in the sexes; except that the female is rather larger and is possessed of a long ovipositor which she carries straight out from her body; and the male has three brown spots disposed in a triangular manner on two of the upper dorsal segments of the abdomen. The colour of both is similar and is of a warm yellow ochre hue, with the eyes, antennæ, and ovipositor dark brown; the wings are of a light brown colour dotted and semi-transparent.

A few of the other peculiarities will be better understood by reference to the drawings and definition.

DEFINITION.

Lava.—A whitish or glaucus grub possessing six minute tubercles, answering to feet.

Metamorphosis.—Coarctate.

Antennæ.—Long, moniliform, contiguous, and composed of 22 articulations.

Mouth.—Mandibulate, possessing labial and maxillary pulpi.

Tarsi.—Pentamerous.

Wings.—Four, incumbent, somewhat opaque and dotted, upper pair areolate; lower incomplete.

Ovipositor.—Extricated, two valved, containing three spiculæ.

Body.—Legs, wings, and ovipositor, covered with short hairs.

EXPLANATION OF FIGURES.

Fig. 1.—A section of a gall, one of the cells of which contains the grub of the ichneumon and the pupa of the proper gall insect.

1 A.—Pupa of gall insect.

1 B.—Grub of ichneumon.

Fig. 2.—Grub of ichneumon, magnified.

Fig. 3.—A section of a gall, containing the cocoon of ichneumon, magnified.

Fig. 4.—The cocoon taken from the gall, do.

Fig. 5.—The dorsal aspect of the pupa or chrysalis taken out of the cocoon.

Fig. 6.—The insect nearly arrived at perfection; head points towards the opening by which the gall insect has escaped.

Fig. 7.—Ichneumon about to emerge from its cocoon.

Fig. 8.—Perfect male insect.

Fig. 9.—Do. female insect.

Fig. 10.—The maxillary and labial pulpi.

Fig. 11.—The ovipositor.

Fig. 12.—Extremity of a half-sheath.

Fig. 13.—Hind leg.

Fig. 14.—Fore leg.

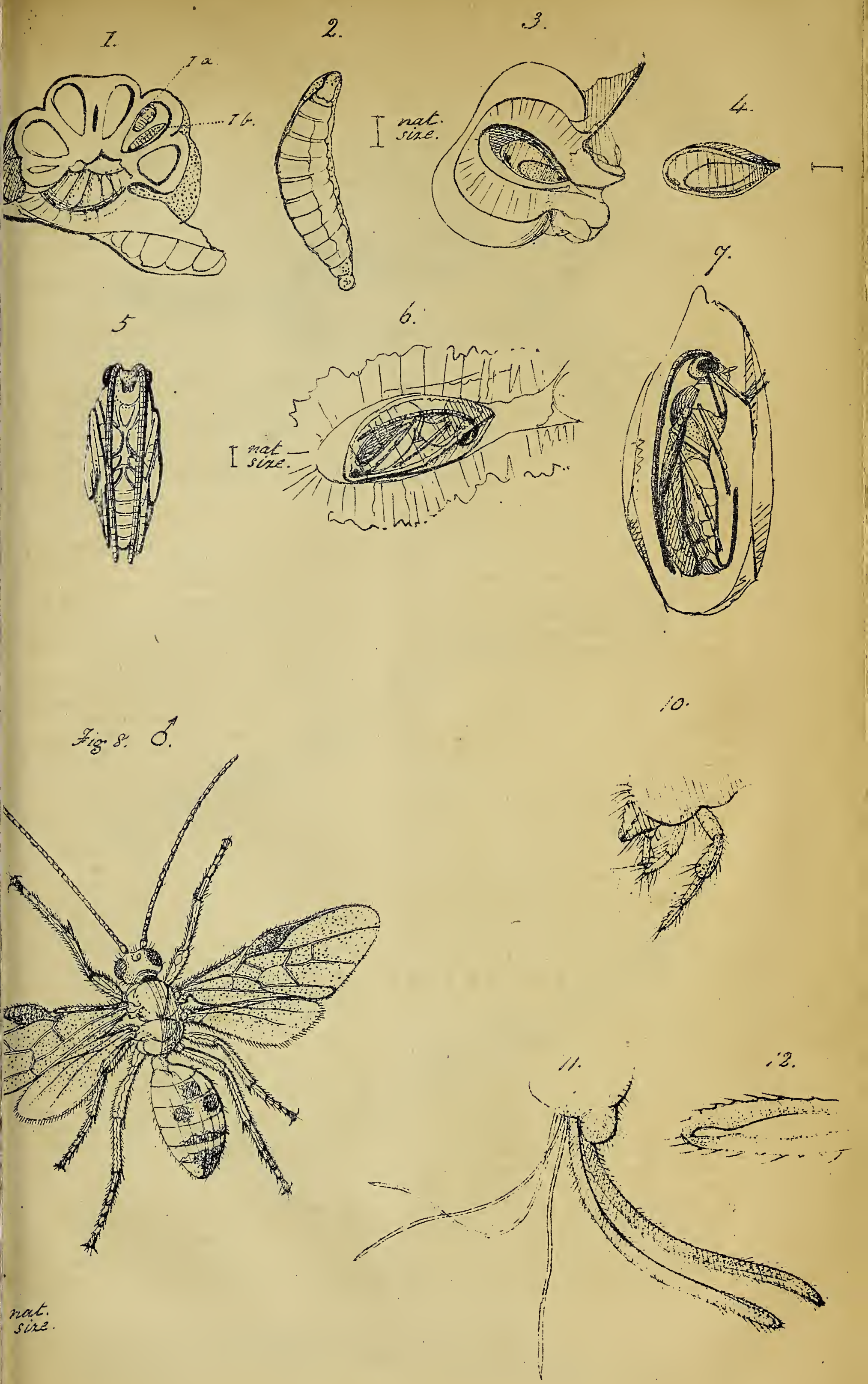
Fig. 15.—The three threads or spiculæ of ovipositor joined.

GENERAL SCIENCE.

NEW MINERALS.

Triphylline, (τρις three and φυλη family), from its consisting of three phosphates. It is described by Fuchs as being crystalline, cleaving in four directions; one of the cleavages is vertical to the others. Two of them are parallel with the sides of a rhombic prism of about 132° and 148°. The primary form is a rhombic prism. Colour greenish gray, in some places blueish; the powder grayish white. In large pieces the lustre is fatty; in thin portions translucent. Specific gravity, 3·6. Hardness nearly that of apatite; fuses readily before the blowpipe. With borax fuses into an iron-cloured glass. It is soluble in acids. It consists of phosphoric acid 41·47; protoxide of iron 48·37; oxide of manganese 4·7; lithia 3·4; silica ·53; water ·68; loss 65.—*Poggendorffs' Annalen*, xxxvi. 473.

Tetraphylline.—This appears to be a variety of the proceeding. It was obtained by Nordenskiöld from Keite, in Finland. It contains phosphoric acid 42·6; protoxide of iron 38·6; oxide of manganese 12·1; magnesia 1·7; lithia 8·2.—*Ibid.*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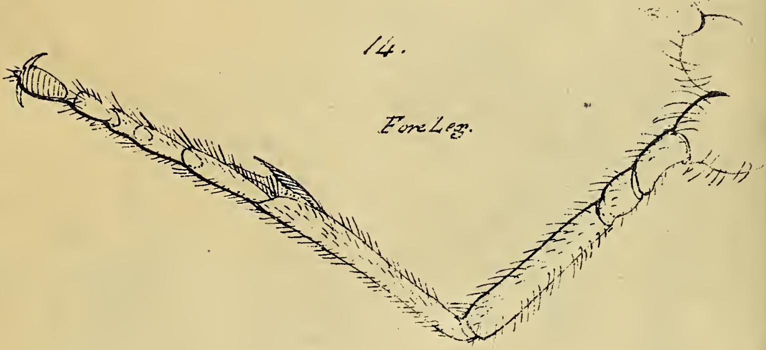

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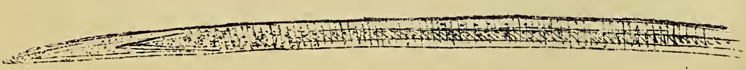


ANAGYRIS FŒTIDA.

THIS tree grows to the height of 8 or 10 feet; the leaves are ternate, alternate, pubescent below, and supplied with a bifid stipula at their summit. It is indigenous to Greece and the southern parts of Europe. The bark, according to Peschier and Jacquemin, consists of a fixed oil, chlorophylle, resin, gum, yellow colouring matter, extractive and a peculiar principle. The latter also exists to a considerable extent in the seeds. It is obtained by submitting them, when dried, to the action of alcohol of ·800 with the assistance of heat; and the product of the digestion in alcohol of ·836; evaporating the liquor to the consistence of extract, dissolving the matter furnished by the alcohol in water in order to separate the resin and oil and evaporate to dryness. Thus prepared the principle is yellow; its taste is bitter, soluble in water and alcohol.—*Memoires de la Societe de Physique et d'Histoire Naturelle de Geneve*, v. 75.

ACTION OF GYPSUM ON VEGETABLES.

PESCHIER finds that the solution of gypsum which has been removed from the furnace is sometimes acid. 2. That the influence of gypsum has no effect upon vegetables except in solution. 3. That on spreading gypsum upon the leaves during rain, its decomposition is effected in direct proportion to its solution, and the surfaces which the leaves present. 4. That its action upon vegetables is due to the influence which the electric fluid exerts upon them, and upon the chemical combination which they absorb; that from the influence of this fluid the decomposition of these combinations, and the formation of new products depend. Hence, the sulphuric acid is set at liberty and combines with potash in the juice. 5. That the electric influence is equal upon the raw and calcined gypsum. Hence, the former is to be preferred. 6. That the roots like the leaves decompose saline solutions. 7. That hydro-chlorate of lime may be employed with advantage. 8. That the influence of gypsum is not confined to leguminous plants. 9. That when spread upon the leaves gypsum has more influence than upon the roots.—*Ibid.* 180.

ON THE SOURCES AND COMPOSITION OF THE DIFFERENT KINDS OF GAMBOGE. BY DR. CHRISTISON; AND ON THE BOTANICAL ORIGIN OF GAMBOGE.

By DR. GRAHAM.

The papers of which the official abstracts are subjoined, were lately read before the Royal Society of Edinburgh.

Gamboge was first made known by Clusius about the commencement of the seventeenth century, as a concrete juice from China. About the middle of the same century, Bontius conceived he had traced it to a particular species of *Euphorbia*, growing in Java and in Siam; from the latter of which countries the whole gamboge of commerce was at that time obtained. About the close of that century Hermann announced that gamboge was produced by two species of trees growing in Ceylon, which have been since often confounded together, but which are now designated by the names *Garcinia Gambogia*, and *Stalagmitis Gambogioides*. About the middle of last century, gamboge was referred by Linnæus to the former of these plants, and his reference was generally admitted; but about thirty years later, Professor Murray of Göttingen conceived he had traced it satisfactorily from the specimens collected by Koenig in Ceylon, and information obtained by the same botanists in Siam, to a new species which he called *Stalagmitis gambogioides*.

Dr. Graham shows, from specimens and drawings sent from Ceylon, both by Mrs. Colonel Walker to himself, and by David Anderson Blair, Esq. to the late Dr. Duncan, that the plant producing Ceylon gamboge is neither *Garcinia gambogia*, as Linnæus thought, nor *Xanthochymus ovalifolius*, as conjectured by Dr. Wight and Mr. Arnott, nor *Stalagmitis gambogioides*, according to Murray and Koenig, but is a species described by Lamarck and Gärtner under the name of *Garcinia* or *Mangostana morella*, although it differs from all of these genera in the structure of its stamens, and, therefore, probably ought to be considered a new genus among those producing a gambogioid juice.

Dr. Christison proved, that, at the present time, Ceylon gamboge is not an article of European commerce, and that the whole gamboge of the markets of this country comes, as in the time of Bontius, from China. After mentioning the analysis of fine gamboge made by Braconnot in France, and John in Prussia, he stated the following as the mean composition of the several varieties of gamboge he has hitherto examined:—

Pipe gamboge of Siam: Resin 72·2; Arabin 23·0; Moisture 4·8; Total 100·0

Cake gamboge of Siam: Resin 64·8; Arabin 20·2; Fecula 5·6; Lignin 5·3; Moisture 4·1; Total 100·0.

Ceylon gamboge sent by Mrs. Colonel Walker: Resin 70·2; Arabin 19·6; Fibre of wood and bark 5·6; Moisture 4·6.

Ceylon gamboge, adhering to a specimen of the bark sent by Mr. David Anderson Blair: Resin 75·5; Arabin 18·3; Cerasin 0·7; Moisture 4·8; Total 99·3.

The proportion of the gum to the resin varied somewhat in each variety, but never differed more than two per cent. from the means given above.

The author added, that he had found the resin to be the active principle of gamboge.

He inferred from the composition of the different kinds of gamboge, and other circumstances detailed in his paper, that the cake gamboge of Siam is not entirely a na-

tural production, but a manufactured article: that Ceylon gamboge, if freed from incidental fibrous matter, corresponds almost exactly with Siam gamboge: that, therefore, they are probably produced by the same plant: that Ceylon gamboge possesses precisely the same medicinal properties; and that this variety, if more carefully collected, may, in all probability, be applied with equal advantage to every economical purpose which is at present served by the finest pipe gamboge of Siam.—*Repertory of Arts, May*, 1836.

A. T.

PRINCIPLES OF CLASSIFICATION IN THE ANIMAL KINGDOM.

By Professor Agassiz.

Although the principal groups of animal are impressed with such characters as to be easily recognised and to admit of little doubt, yet their order and succession have been determined by no general principle. This appears from the discrepancy in the position assigned to them by the most eminent systematists, each of whom has assumed, arbitrarily, some organ or system of organs for the basis of his arrangement. Professor Agassiz, (at the last meeting of the British Association), after adverting to some German naturalists who alone have sought after a general principle which should be satisfactory to "philosophic naturalists," passed in review the classes of the animal kingdom, each of which, he stated, exhibited in an eminent degree the development of some one of the animal functions. While vertebrate animals (with man their type) arrive at the greatest perfection in the organs of the senses, the invertebrate offer in the class of worms the representative of the system of nutrition, in *crustacea* of circulation, in insects of respiration, and in *mollusca* of generation. The Professor next proceeded to demonstrate in what manner each subclass of vertebrate animal derives its peculiar character from some one element of the animal economy.

This predominant element is the bony skeleton in fishes, the muscular structure in reptiles, the sensibility of the nervous system in birds, and the perfection of the senses in *mammalia*, which therefore reproduced the distinguishing character and constitute the type of vertebrate animals. He next showed that each of the other subclasses of the higher group is represented among the *mammalia* along with its own peculiar type. He explained his reason for the fourfold division which he had adopted in the subclass, pointing out the close affinity which connects the *ruminantia*, the *pachydermata*, the *rodentia*, the *edentata*, and the herbivorous *marsupialia*, (in none of which is the true canine tooth developed,) which he considers as forming a single group; in another he unites those characterized by the presence of the canine tooth in its proper function, (as an instrument of nutrition, not merely of defence,) viz. the *carnivora* and those *marsupialia* which partake of their character, and the *quadrumana*. The *cetacea* form a group in themselves; and man another. The manner in which these represent the subclasses of *vertebrata* was exhibited by the comparison of

Cetacea,	with	Fishes,
Ruminantia, &c.		Reptiles,
Carnivora, &c.		Birds;

while man is the perfection and type of the mammiferous conformation.

Professor Agassiz then applied this principle to illustrate the order and succession of the groups in *mammalia*, by a reference to the order in which the fossilized remains of the *vertebrata* occur in the stratified deposits: 1. fishes, 2. reptiles, 3. birds, 4. mammalia. From the same consideration results the following arrangement of the representative groups among these last; 1. *cetacea*, 2. *ruminantia*, &c., 3. *carnivora*, 4. man, who thus in a twofold aspect becomes the culminant point of the animal creation.*

ISINGLASS.

From the experiments made by Mr. Smith in the United States, it appears that the intestines of the fish the *gadus merluccius* furnish the purest species of isinglass, (*Journ. de Pharm.*) not inferior to that obtained from the sturgeon. The swimming bladder of this fish is larger than that of other species of the same family. It is cut out and washed with pure water, and then dried in the sun. When partially dry it is pressed between wooden rollers as thin as paper. The long stripes of isinglass which are met with in commerce, are the intestines of the *gadus morrhua*.†

SPONTANEOUS PLANTS.

Few things are more extraordinary than the unusual appearance and development of certain plants in certain circumstances. Thus, after the great fire of London in 1666, the entire surface of the destroyed city was covered with such a vast profusion of a species of a cruciferous plant, the *Sisymbrium irio* of Linnæus, that it was calculated that the whole of the rest of Europe could not contain so many plants of it. It is also known that if a spring of salt water makes its appearance in a spot, even a great distance from the sea, the neighbourhood is soon covered with plants peculiar to a maritime locality, which plants, previous to this occurrence, were entire strangers to the country. Again, when a lake happens to dry up, the surface is immediately usurped by a vegetation which is entirely peculiar, and quite different from that which flourished on its former banks. When certain marshes of Zealand were drained, the *Carex cyperoides* was observed in abundance, and it is known this is not at all a Danish plant, but peculiar to the north of Germany.—In a work upon the useful Mosses by M. de Brebisson, which has been announced for some time, this botanist states that a pond in the neighbourhood of Falain

* Philosophical Magazine No. 43.
† Thomson's Records, No. 3.

having been rendered dry during many weeks in the height of summer, the mud, in drying, was immediately and entirely covered, to the extent of many square yards, by a minute, compact, green turf, formed of an imperceptible moss, the *Phaseum axillare*, the stalks of which were so close to each other, that upon a square inch of this new soil, might be counted more than five thousand individuals of this minute plant, which had never previously been observed in the country.*

BAROMETRICAL OBSERVATIONS,

By Sir John Herschel.

BAROMETRIC COMPARISONS.—Sir J. Herschel's fine mountain barometer having been accurately compared with the Standard barometer of the Royal Society, accompanied him in an extensive scientific tour which he made through France, Germany, Switzerlend, Italy, and Sicily, and was on that occasion succesively compared with the other barometers in the principal observatories of Europe. On his return to England it was again compared with the Standard of the Royal Society, and although it had ascended with Sir John to the craters of Vesuvius and Etna, (in the latter case " under circumstances very trying to the instrument,") it was found to give the same difference within the three-thousandth of an inch as that obtained in the first instance before setting out. 2. In 1832, the same mountain barometer was lent to Professor Henderson, on his going out as Astronomer Royal to the Cape, and, having been compared both on setting out, and again in the following year on his return, the second difference was on this occasion the same as in the former case,—namely, only the three-thousandth of an inch. 3. Before Sir John Herschel's leaving England in 1833, it was again compared with the Royal Society's Standard, (giving the same difference as before,) and, on his arrival at the Cape, was compared with the barometer of the Royal Observatory in that colony; the determination of altitude in this latter instrument, as compared with the Royal Society's, by the intermedium of the mountain barometer, being the same within the five-thousandth of an inch as made on the former occasion by Professor Henderson; the mountain barometer having, in the course of these comparisons, made three voyages to and from the Cape.

EQUATORIAL DEPRESSION.—Sir John Herschel, in the observations made during his voyage out to the Cape, remarked the interesting phenomenon, that " the barometer under the Equator has a *lower mean altitude* than in north or south latitude, and that the increase of altitude is steadily maintained at least as far as either tropic—the equatorial depression amounting to about two-tenths of an inch. The physical cause is not far to seek. It consists in the *upward suction*, which is the immediate consequence of the overflow of the equatorial atmospheric column into the extra-tropical regions, and which is not immediately compensated by the undercurrent of the Trades. It is a dynamical result, into which time enters as an essential element. In this (as in the tides) equilibrium is not established *instanter*, and this gives room for the development of appreciable differences of tension in different parts of the circuit."

BAROMETRIC FLUCTUATION.—Sir John Herschel states that he has, since his arrival at the Cape, been collecting data for an inquiry into the laws of barometric fluctuation in those regions, and, having fortunately met with a fine series of fifty-seven months' observations by Capt. Bance, registered in Cape Town, he has undertaken the labour of reducing them. "They exhibit an extremely regular fluctuation of three-tenths of an inch, by which the barometer stands higher in July than in January. On the other hand, by the Calcutta Registers, as published by Prinsep, for the last two years and a half, it appears that the reverse obtains there,—the barometer standing higher in January than in July by about ·52 inch. Thus, it appears that there is an annual bodily transfer of a certain considerable mass of air from hemisphere to hemisphere; and of this, too, the cause is obvious, being the more heated state of that hemisphere over which the sun is vertical, in comparison with that on which he shines obliquely."

FOOT-MARKS OF UNKNOWN ANIMALS AND BIRDS IN NEW RED SAND-STONE.

Our geological readers are familiar with the description, by Dr. Duncan, of the traces of animal impresstions in the new red sandstone of Dumfries-shire. Traces of unknown animals have recently been detected in a similar rock, at Hildburghausen, in Thuringia, by M. Lickler. Traces of four species of different animals can be observed. Two footmarks are always found together; one behind about six inches long, the other before, only half as large. The toes are five. The large toe is situated at a right angle in relation to the others. The two large toes of one pair of feet are directed always from the same side, but the same toes of the following pair are directed in the opposite way. The animal must, therefore, have ambled. A remarkable feature is, that the pairs of feet follow in a right line :—hence the animals must, when they walked, have raked the earth. Count Munster considers them to have been amphibia; Weiss, on the contrary, mammiferae; while Link beleives them to have been gigantic sauri, like the chameleon. —(*Bibliotheque Universelle*, 1835, vol. ii. 399.)

The first traces of birds, however, in a similar situation, have been discovered on the banks of the Connecticut river, in Massachusetts; and described by Professor Hitchcock, of Amherst College. The appearance presented is that of the feet of a bird which had been walking in the mud. The

* Jameson's Journal, No. 39.

depressions are more or less perfect and deep; and have been made by an animal with two feet, and usually three toes. In a few instances a fourth, or hind toe, can be observed, not exactly in the rear, but inclining somewhat inward; and in one instance, the toes all point forward. Sometimes these ternate depressions run into one another, as the toes approach the point of convergence, but they also sometimes stop short of that point, as if the animal had not sunk deep enough to allow the heel to make an impression. Attached to the posterior impression, there is frequently an appendage resembling a tuft of hairs or bristles. In all cases, where there are three toes pointing forwards, the middle one is the longest. Mr. Hitchcock found these impressions to correspond closely with those formed by small species of recent grallae, particularly snipes. He divides the tracks in the sand-stone into 7 species, under the genus *Ornithichnites*. 1. Pachydactyli; O. *giganteus*; O. *tuberosus*; Leptodactyli; O. *ingens*; O. *diversus*; O. *tetradactylus*; O. *palmatus*; O. *minimus*.—(*Silliman's American Journal*, xxix. 307.

1. SULPHURET OF NICKEL AND BISMUTH.—This mineral is found in the district of Syan Altenkirch, occurring along with quartz and copper pyrites. It crystallizes in octahedrons. Lustre metallic. Colour, light steel gray. Hardness, between that of fluor spar and apatite. Before the blow-pipe, upon charcoal, it gives out in the oxydating flame the odour of sulphurous acid, and after being long exposed to the blast, leaves a metallic-grain which is attracted by the magnet. It affords no fumes of arsenic or antimony. With soda, a sulphuret is obtained and a white metallic grain which is magnetic. With borax, in the oxydating flame, a transparent brown glass is formed; in the reducing flame, a glass possessing a similar colour but mixed with precipitated nickel. With salt of phosphorus a brown glass is formed, which on cooling, becomes faintly green. The specific gravity could not be determined, in consequence of the quartz with which it was mixed. It dissolves readily in acids. Its constituents, according to Kobell are, sulphur 38·46; nickel 40·65; iron 3·48; cobalt 0·28; bismuth 14·11; copper 1·68; lead 1·58. Its composition may be represented by 8 Nk Sl +Bs S 4.—(*Journal fur praktische Chemie*, vi. 332.)

2. OERSTEDITE.—This mineral described by Forchhammer, occurs at Avendal, commonly seated in augite crystals. Colour, brown-splendent. Crystals belonging to the compound pyramidal system. The terminal angle of the first pyramid is 123° 16' 30". The shape has some resemblance to that of Zircon, the angle of which is 123° 19'. Specific gravity 3·629. Hardness, between felspar and apatite. It consists of silica 19·708; lime 2·612; magnesia 2·047; protoxide of iron 1·136; titanic acid and zirconia 68·965; water 5·532; manganese a trace.—(*Poggendorff's Ann.* xxxv. 630.)

3. BIN-ARSENIET OF NICKEL.—Mr. Booth has analyzed this mineral, from Riechelsdorff, in Hess. Its colour is tin white with a tinge of blueish gray. Fuses before the blow-pipe into a metallic bead, giving out arsenic and into a blue glass with borax. Its constituents are, nickel 20·74: cobalt 3·37; iron 3·25; arsenic 72·64. The nickel and cobalt were separated according to the method of Laugier, that of Phillips having failed after repeated trials.—(*Silliman's Journal*, xxix, 241.)

THE INDIA REVIEW.

Calcutta: November 15, 1836.

LORD AUCKLAND'S SCIENTIFIC PARTY AT THE GOVERNMENT HOUSE.

At a period when Science and the Arts are throwing their dazzling light over all parts of Europe, by the operations of that splendid institution, the British Association, it is with no common feelings of exultation and delight that we behold the dawning of a similar era in British India; the more so when the avenues are seen to open at the residence of the first person in these realms. By this act the Governor General is infusing in the bosoms of the people under his rule a spirit of emulation and rivalry, in the glorious strife for new discoveries promotive of good as regards Science, the Arts, and the prosperity of our eastern possessions.

On the 8th Instant there was a party at the Government House, to which, gentlemen of scientific pursuits and attainments were invited, with the view of bringing forward interesting discoveries regarding General Science.

This portion of our Editorial matter is so nearly being printed off, that we can give but a faint sketch of what occurred on this occasion. Among some beautiful collections in Conchology, Botany, Hindoo Sculpture; drawings by Hodgson, MacClelland, and Cantor on Nepal, Assamese, and Bengal Zoology, there was a splendid cabinet of insects, collected and prepared by the ingenious and talented curator of the Asiatic Society, Mr. Pearson.

The socket of the thigh bone of the elephant, taken out of a rock at Seoonee by our intelligent and esteemed friend George Spilsbury, Esq. and plans of the building to celebrate the never to be forgotten Liberation of the Indian Press were on the table and rigidly criticised and surveyed. By the way, we must not omit to mention that this was the best proof, which the Noble Host could give of his sentiments regarding his countryman and predecessor's proudest boast—The Liberty of the Press. May this ever be the motto of the Government House, in the capital of India. But for the freedom of the press, science would have been smothered in its infancy by those who are the persecutors and oppressors of the advocates of free discussion.

The entertainments of the evening commenced on the entrance of Lord Auckland, when Dr. O'Shaughnessy exhibited a working model of a machine made by himself, producing moving power by the application of electro-magnetic influence. The Reverend Mr. McCauley of the British Association exhibited the working model of a machine for producing this power, and which is described at page 137 of our Journal, to which we must refer our readers. The exhibition of the model by Mr. McCauley was received with sincere and reiterated applause, and many scientific men present expressed sanguine expectations of the value of the method in a practical point of view: a similar feeling was evinced by the whole of the Governor General's party, on witnessing the ingenious working model of another machine by Dr. O'Shaughnessy. The subject is one of the highest importance. We beg to call the attention of our readers to two papers, in our present number on the application of electrico-magnetic power to mechanics: one is illustrated by a lithographic drawing of the instrument originally constructed by Mr. Saxton, but improved upon by Mr. Watkins. Our last accounts mention that it is exhibited at the Gallery of Practical Science; for contrivance, the writer adds, none can vie either in simplicity or in beauty of design.

But to return to the party,—at another table, to which, in consequence of the crowd, we could not obtain access, we understand the galvanic force from the ordinary magnet was developed by an ingenious apparatus belonging to Mr. J. Prinsep. Water was decomposed, and other interesting powers of the magnet shown.

As taste becomes pure, meetings of the nature we have described, will be the means of bringing forth a diversity of genius—to the exercise of faculties which otherwise would have lain dormant—to the meditation on the labours of others, which would otherwise never have been thought of, and finally lead to the enchanting paths of distinction and celebrity, marking the superiority of intellectual, solid, and real pleasures over those of a frivolous and trifling nature, where the mind is never beneficially and fully developed.

We know there are men in this country who will differ from us in regard to our expectations as to the great ulterior good to be derived from Lord Auckland's scientific parties. There are some who conceive that in India there is a deficiency of genius and talent. Granting the aspersion as just by way of argument, yet we repeat the encouragement will inspire what D. 'Israelli, calls scientific industry,—"the art which seizes, as if it were, with the rapidity of inspiration, whatever it discovers in the works of others, which may enrich its own stores; which knows by a quick apprehension what to examine and what to imbibe; and which receives an atom of intelligence, from the minds of others, on its own mind, as an accidental spark, falling on a heap of nitre, is sufficient to raise a powerful blaze."

Dr. McCLELLAND.

It is with great regret we learn that this zealous geologist is about to return to his regiment, on account of the Mission, of which he was a member, being dissolved. Is a man of his scientific acquirements, which we have so fully shown in our review of his valuable work on the Geology of Kemaon, to be circumscribed in the great work of scientific research and instruction? Are his capabilities of advancing the cause of Science by developing the latent resources of this country to be confined within the narrow walls of a native regimental hospital? Science has surely stronger claims, and at least for her sake, we earnestly and sincerely hope they may be attended to.

PROGRESS OF SCIENCE,

AS APPLICABLE TO THE ARTS AND MANUFACTURES; TO COMMERCE. AND TO AGRICULTURE.

METHOD OF DETERMINING THE VALUE OF BLACK OXIDE OF MANGANESE FOR MANUFACTURING PURPOSES. By THOMAS THOMSON, M.D., F.R.S., L. AND E. *Regius Professor of Chemistry in the University of Glasgow.*

THE manganese to be tested must be reduced to a fine powder or brought into the state in which it is used by the manufacturers of bleaching-powder. To determine its value, proceed in the following manner:

Into a balance Florenced flask put 600 grains of water, and 75 grains of crystals of oxalic acid. Then add 50 grains of the manganese to be tested; and, as quickly as possible, pour into the flask from 150 to 200 grains of concentrated sulphuric acid. This is best done by having a given weight of sulphuric acid, say 210 grains previously weighed out in a glass measure, counterpoised on one of the scales of a balance. You pour into the flask as much of the sulphuric acid as you can conveniently. Then, putting the measure again into the scale, you determine exactly how much has been put in.

A lively effervescence takes place, and carbonic acid gas is disengaged in abundance. Cover the mouth of the flask with paper, and leave it for 24 hours; then weigh it again. The loss of weight which the flask has sustained isexactly equal to the quantity of *binoxide* of manganese in the powder examined. Thus, let the loss of weight be 34 grains; the quantity of binoxide of manganese in the 50 grains of the powder which was tested will be 34 grains ; or it will contain 68 per cent. of pure binoxide of manganese, and 32 per cent. of impurity.

To understand what takes place, it is necessary to recollect that oxalic acid is composed of 2 atoms carbon 1·5;3 atoms oxygen 3 ; total 4·5; and that binoxide of manganese is composed of 1 atom manganese 3·5; 2 atoms oxygen 2 ; total 5·5.

The oxalic acid acts on the binoxide by abstracting one-half of its oxygen, which converts it into carbonic acid; hence the effervescence. 55 grains of pure binoxide of manganese would give out 10 grains of oxygen, which would convert 45 grains of oxalic acid into 55 grains of carbonic acid which escaping, indicate, by the loss of weight, the quantity of carbonic acid formed. Nows it happen, that the weight of the carbonic acid formed isexactly equal to the quantity of binoxide of manganese which gives out its oxygen to the oxalic acid. Hence, the reason of the accuracy of the test.

In other words, an integral particle of binoxide of manganese, which weighs 5·5, gives out 1 atom of oxygen. This atom of oxygen combines with an integrant particle of oxalic acid, weighing 4·5, and converts it into two integrant particles of carbonic acid, which both together weigh 5.5. As this carbonic acid escapes, the loss of weight must be just equal to the quantity of binoxide of manganese in the powder subjected to experiment.

In practice, I find that a small quantity of the binoxide of manganese sometimes escapes the action of the oxalic acid, being probably screened by the great quantity of impurity with which it is mixed. But the deficiency of carbonic acid occasioned by this is about made up by the moisture which the carbonic acid gas carries off along with it. This renders the error in general trifling.

It will be proper to subjoin an example or two of the method of proceeding, to enable the reader to judge of the goodness of this test, and its value to the manufacturer.

The black oxide of manganese employed was subjected to analysis, and found composed of Binoxide of manganese 68.49 Peroxide of iron 11.85 ; Water 5.6;8 earthy matter 13.98 ; total. 100.00

Experiment 1.

Put into the flask—	Water	599 grs.
	Oxalic acid ..	75,
	Black oxide ..	50,
	Sulphuric acid	184,
	Total ..	908

Loss of weight 32·5 grains. It ought to have been 34-245 grains. Error 1·745 grains.

Experiment 2.

Put into the flask—	Water	600 grs.
	Oxalid acid .	75,
	Black oxide .	50,
	Sulphuric acid	154,
	Total	879

Loss of weight 34·5 grains. It ought to have been 34.245 grains. Here the error is in excess, and amounts to 0·255 grains.

Experiment 3.

Put into the flask—	Water	600 grs.
	Oxalid acid	75
	Black oxide.	50
	Sulphuric acid	154·1
	Total	879·1

Loss of weight 35 grains. Here also the error was in excess, and amounted to 0.755 grains.

Let us take the mean of these three experiments:

Loss of weight by 1st	.. ..	32·5 grs.
2nd	......	34·5
3rd	......	35·0
	3)102	
Mean		34 grains.

Here the error amounts to 0·245 grains which is considerably less than 1 per cent. If, therefore, three trials be made, the error will be under 1 per cent.; so that the method is quite sufficient to indicate very nearly the quantity of binoxide of manganese in any ore. Now, it is the binoxide of manganese alone that is useful to the manufacturer; the sesqui-oxide and red oxide availing very little in the preparation of chlorine, for which almost alone the ore is used by manufacturers.

I tried various other proportions of the ingredients, but found the preceding the best. I tried, also, the effect of rubbing up in a mortar the oxalic acid and black oxide. But the error is least when the oxalic acid is merely poured into the water, and the black oxide added before the acid is dissolved. Unless the sulphuric acid be added last, we cannot be sure of our weights.

ON THE APPLICATION OF ELECTRICO-MAGNETIC POWER TO MECHANICS.

By M. J. D. Botto, Turin.

The singular energy with which magnetic action is developed in soft iron, under the influence of electricity in motion, is well known.

As the possibility of applying this new power to mechanical purposes involves a subject of much interest, I have been induced to make known the results which I have obtained.*

The mechanism which I employed consists of a lever put in motion, after the fashion of a metronom, by the alternate action of two fixed electrico-magnetic cylinders, operating upon a third cylinder which is moveable, and attached to the lower arm of the lever, whilst the superior arm maintains a constant swinging movement; which is regulated, in the ordinary method, by a metallic wheel.

The apparatus was so disposed, that the axes of the three cylinders, all perfectly equal, being situated in the same vertical plane, and perpendicular to the axis of motion, the oscillatory cylinder, by one of its extremities, alternatively came in contact with, and in the direction of, the one or the other of the other two cylinders, placed at the extreme limits of its movements: and each time, at this very instant, the direction of the magnetizing current in its spiral was changed, the rest of the circuit maintaining the same direction, so as to produce poles of the same name with those in the fixed cylinders, at the two extremities, situated in relation with the moving cylinder. The change of direction, which we have just been mentioning, is obtained with the help of a piece of mechanism, on the principle of a balance, and known under the name of a *Bascule*, where the very movement of the machine itself inverts the communications.

It is clear that, on account of this arrangement, the middle cylinder must undergo alternating agreeing influences of attraction and repulsion, in virtue of which the mechanism puts itself in motion, to all appearance spontaneously, and so actively maintains it, by the arrangement of the magnetic forces which incite it, and which are sustained by the electrical currents.

I have tried to succeed without the spiral of the middle cylinder, by making the two fixed magnetized cylinders alternately act upon it. An adhesion, however, which continued after the cessation of the magnetic currents, very much diminished the mechanical effect; whilst, on the other hand, in the other arrangement, the adhesion not only ceased, but was converted to a certain extent into repulsion, with a rapidity equal to that of the current itself, which, scarcely for an instant interrupted by the play of the *(bascule)* pendulum, precipitated itself (the communication being inverted) into the spiral of the middle cylinder, in a contrary way to its former direction, at the same time resuming its ordinary course in the other two spirals.

The movement of the lever, and of the regulator, resulting from this arrangement, is perfectly free. Commencing slowly, it speedily and by degrees acquires the maximum of the velocity which the energy of the currents which produce it allows of, a velocity which is then maintained as equally as the intensity of the current itself, and as long as the electrical influence is preserved.*

On the present occasion I shall say nothing concerning some observations I had made upon the employment of various acid and saline solutions, and also of sea-water.

Much interest is excited by the contemplation of these novel effects of a power, which exhibits itself in a manner so different from that seen in most other bodies; and we are almost tempted to anticipate flattering results from those ulterior applications, to which the management of this mysterious agent may lead.†

* I may here remark, that the expectancy of giving a wider range to my experiments, and also my being under the necessity of leaving town, have produced considerable delay in the publication of these facts. I have now, however, determined to announce them, from having seen in the last number of *Gazette Piemontaise*, that M. Jacobi of Konigsberg has succeeded in obtaining perpetual motion simply by means of electrico-magnetic influence.

* There is a great similarity, both as it regards the general arrangement of the apparatus and the nature of the moving principle, between the mechanism of M. Botto and the electrical clock of M. Zamboni. This clock is put in motion by a pendulum, which is alternately attracted and repelled by the poles of two dry galvanic piles, which are known under the name of Zamboni's piles.

† The Chevaliers Avogrado and Bidare, who have both seen the apparatus in movement, have given expression to their surprise, not so much on account of the novelty of the fact, as on account of the speculations it suggested to those able men, respecting the general connexion which might subsist between this simple result and the progress of science and mechanism.

The dimensions of the apparatus just described are very inconsiderable, and such that the current arising from fifteen plates, 9 inches square, can produce the movement. The electro-dynamic cylinders, which principally determine the limits of the mechanical effect, are 4 inches in length, and about half an inch in diameter; they are surrounded by a spiral thread 130 feet long, of the thickness of about the fiftieth of an inch. The lever is of wood: the superior and inferior arms are respectively of the lengths of 14 and 3 inches; the extent of the oscillations is 15 degrees. In fine, the regulator weighs about 5 pounds, and the entire weight of the whole is about 11 pounds.

Considerations, which readily offer themselves on a comparison of the maximum magneto-mechanic effect of this apparatus, and the size of its different parts, have suggested the substitution for the cylinder of the ordinary horse-shoe form of electrico-magnetic bars, and the augmentation, within certain limits, of the number and size of these bars, and also of the length of the spirals.

As I have not finished my experiments on this subject, I shall at present confine myself to the statement of the foregoing facts; which I have thought it expedient to publish, not only on general scientific grounds, but also because the study of the new kind of effects to which it belongs, may be considered as fruitful of important mechanical results.*

PRESERVATION OF ANIMAL MATTER.

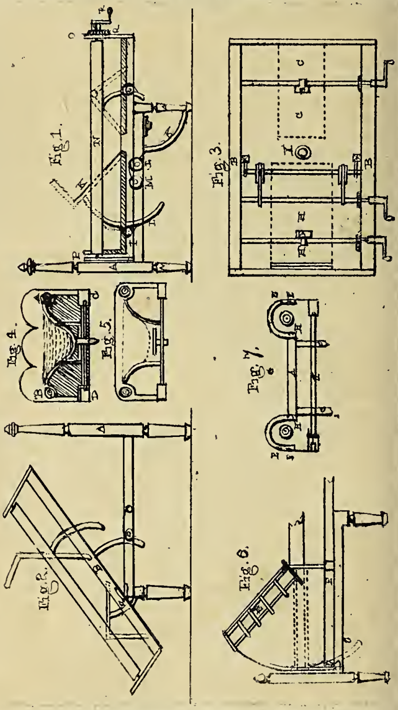
At a late meeting of the Asiatic Society, a human hand, and a piece of beef, preserved by means of preparation of vegetable tar, found on the borders of the Red Sea, in the vicinity of Mocha, and a specimen of the tar, were presented by Lieutenant-Colonel Bagnold. In an accompanying letter Colonel Bagnold observed—"During my residence as Political Agent on the Red Sea, a conversation with some Bedouin Arabs, in the vicinity of Mocha, led me to suspect that the principal ingredient used by the ancient Egyptians in the formation of mummies was nothing more than the vegetable tar of those countries, called by the Arabs *katraan*. My first trials were on fowls and legs of mutton, and which, though in the month of July, and the thermometer ranging 94° in the shade, succeeded so much to my satisfaction, that I forwarded some to England; and have now the pleasure to send, for the Society's information and inspection, a human hand, prepared four years ago by my brother, Captain Thomas Bagnold. The best-informed among the native Arabs think that large quantities of camphor, myrrh, aloes, and frankincense, were used; these specimens will, however, prove that such were by no means necessary, as the tar, when applied alone, penetrates and discolours the bone. The tar is obtained from the branches of a small tree, or shrub, exposed to a considerable degree of heat, and found in most parts of Syria and Arabia Felix."—*Athenæum.*

* Jameson's Journal, No. 35.

SPECIFICATION OF THE PATENT GRANTED TO JAMES CHERRY, OF THE CITY OF COVENTRY, PAINTER, CARVER, AND GILDER, FOR CERTAIN IMPROVEMENTS ON BEDSTEADS OR APPARATUS APPLICABLE FOR THE EASE AND COMFORT OF INVALIDS AND OTHERS.

Sealed January 15, 1835.

WITH AN ENGRAVING.



To all to whom these presents shall come, &c. &c.—*Now know ye,* that in compliance with the said proviso, I, the said James Cherry, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following description thereof, reference being had to the drawings hereunto annexed, and to the figures and letters marked thereon, (that is to say):—

My invention consists in certain arrangements of apparatus and machinery attached to bedsteads or other frame work applicable to repose, by which a greater degree of ease and comfort is imparted when the body is in the recumbent posture, and by which the position of the body may undergo various changes with less trouble and inconvenience. But in order that my invention may be most fully understood, I will describe the drawings hereunto annexed.

Fig, 1, shews a side view of a bedstead. A, A, is the standard frame. B, is the bed frame resting upon the standard frame, to which it is attached by hinges (marked *a*). C, is a frame to elevate the knees, placing the limbs on a double inclined plane, the frame is raised in the centre or knee point (which is rule jointed) by turning with the windlass to the left hand. The roller marked, D, round which is a belt or strap attached to the bottom of the quadrant marked, E, as the roller turns round the strap, draws up the quadrant, and raises the knee-frame to what elevation is required. A ratchet-wheel is fixed upon the roller, D, and is stayed by a catch when the frame is at the required height. G, shows the position of the knee-frame when not in use. H, is the bed-rest or frame for raising the body. I, is a roller and ratchet-wheel with strap round the roller attached to the bottom of the quadrant, J. By turning the roller to the right the quadrant is drawn up and raises the bed-rest at the head, which is also stayed when at its required elevation by the catch and ratchet. J, J, shews the bed-rest when not in use. K, shews one of two quadrants attached to the bed-frame, one on each side. L, is a roller, on which are two straps one attached to each quadrant, K. On the roller L, are also two wheels or drums three times the diameter of the roller; round each wheel or drum is another strap, which is also attached to the roller marked, M, on which roller is a ratchet-wheel; the roller, M, is the moving power when it is turned to the right hand, the straps, connected to it, and the power-wheels or drums on, L, revolve the roller, L; and by the straps on, L. attached to the quadrants, K, the whole bed-frame is elevated at the head turning upon the hinged pivot (*a*), but which will be better understood by referring to drawing, fig. 2. The necessity of two rollers and power-wheels in this movement is obvious. The weight of the bed-frame and machinery, together with the bedding and the body would be too great for a single power. Thus by adding a second roller with power-wheels, the force required to raise the bed frame is reduced in the same proportion as the roller, M, is to the power-wheel, L, or one third the position of the quadrants, K, J, and E; the rollers, straps, drums, ratchets, &c. will be more clearly comprehended by referring to fig. 3, that being a ground plan. N, shews one of two cylinders running lengthwise one on each side the bed-frame. These cylinders revolve each upon an axis running through them, the pivots of the axis acting in the head and foot boards of the bed-frame marked, O and P. The axis is fixed by a ratchet-wheel and catch at the foot end marked, Q. Inside each cylinder are two springs upon the chronometer principle, but proportionately stronger, one near each end. The springs are attached like those of the chronometer to the axis and to the cylinder. The bed sacking is attached to the cylinders, being three times the width of the bed-frame, one third of the sacking is wound round each cylinder, the other occupics the space between them; when the springs are set up, which is done by winding the axles by the windlass (R) outwards or right and left from the centre, the sacking is drawn tight, as is shewn by dotted lines from each cylinder in figs. 4 and 5. The bedstead is thus ready for use, and the bedding is made up on it in the usual way. When you lay down upon the bed, the weight of your body causes each cylinder to revolve inwardly upon its axis (which is fixed by the ratchet and catch), and according to the strengh with which the springs are set up, the sacking with the bedding is compressed to a concave of any depth from three to twelve inches (see fig. 4, dotted lines), the body riding in an undulating motion supported by the springs, and the back being relieved from pressure, which is imparted equally to the sides and shoulders. When the position of the body requires changing, set the axis of either cylinder at liberty by pressing upon the windlass, R, fig. 1, and freeing the ratchet from the catch, then gently let the cylinder revolve with the axle until the sacking, &c. is received by the concave platform (described by the double line in fig. 4.). The weight is now supported by the platform, and the springs of the cylinders are kept inactive by bolting the catches off the ratchets. As the bedstead is now arranged, the body may undergo the various changes by revolving the cylinder, A, fig. 4, outwards; the sacking which occupies the space across the platform, and on which the bedding and the body rest, coils round the cylinder, and its place is supplied by the sacking from the cylinder, B, fig. 4. The bedding is carried with the sacking over the cylinder, A, whilst the body gently turns in the concave, and is placed on its right side; one revolution of the cylinder effects this, and a second; places the body on its chest. A counteraction on the cylinder, B, produces the same changes on the left side; a change of bed and bedding is thus effected. On a table placed along side the bedstead, make up the fresh bedding in the usual way, but intersecting it with the bedding already in use. The fresh bed and sheet being placed over the cylinder and under the bed in use, wrapping under about twelve inches; thus prepared, revolve the opposite cylinder outwards, this draws the sacking over the platform, the two beds and bedding going with it. That in use is drawn over the cylinder on to the floor, and its place is occupied by the fresh supply with the patient on it, he having gently turned over once during the change. X, shews the bed-pan and groove frame in which it slides.

Fig. 2, shews the bedstead when converted into an easy chair. First raise the knee-frame to an angle of forty-five degrees, which is marked on the quadrant; this forms the chair-seat; next raise the bed-rest to an angle of thirty degrees (also marked on the quadrant); this forms the chair back. Lastly, elevate the bed-frame to forty-five degrees (also marked on the quadrant) and chair is complete.

Fig. 3, is a ground plan shewing the positions of the vaious rollers, straps, drums,

ratchets, and quadrants, the whole of which have been already explained in the reference to fig. I. The spaces marked by the dotted lines are the knee-frame, C, C. And the bed-rest, H, H. The circle marked, X, is the aperture in the platform under which the bed-pan is placed.

Fig. 4, is a section of the bed-frame at the head board. A, B, shews the two cylinders. C, D, the side posts (marked B in fig. 1) E is the roller extending across the bed-frame by which the bed-rest, F, F, is raised. G, is a portion of the quadrant; the double black line shews the concave platform, the diagonal lines shew the bearers of the platform, those bearers resting upon the bed-frame; the top dotted line from the cylinders shews the line of sacking when strained by the springs and free from the pressure of the body; the other lines shew different degrees of compression by the body according to its weight or the strength with which the springs are set up.

Fig. 5, shews a section of the foot board platform, and knee-frame.

Fig. 6, represents a portable bed-rest affixed on the bedstead as it may be wanted occasionally. A, is a frame of brass or other metal supported by a standard (also of metal) marked, B, which is secured to the outside of the bed-frame at, F. The frame, A, is attached to the standard, B, by a pivot on which it turns. C, is a quardrant by which the bed-rest is raised at the head, actuated by a roller and strap, D. E, shows the bed-rest when elevated; a corresponding frame is on the other bed-post, and the two are connected at the head by a board marked, A, fig. 7. To the board, A, are fixed two quadrants, C, C, fig. 7, actuated as has been already explained by the roller, B, fig. 7, and D, fig. 6. The upper bar of the frame runs parallel with the top of the cylinder. A sacking is laid across from cylinder to cylinder, and, passing over the top bars of the frame is fastened to the lower bar by straps upon studs, which are described by the four dots.

Fig. 7, shews the head of the portable bed-rest. A, is the board connecting the two metal side frames. B, is the roller. C, C, the quadrants. D, D, shews the ends of the metal side-frames which sweep round the tops of the cylinders from, F, to H. E, E, are the top bars. F, F, the lower bars and studs. G, is the sacking of the bed-rest, extended across the bedstead, and strapped to the studs of the lower bars, F, F.

The bed sacking, as before stated, is required three times the width of the bedstead; in the sacking are two apertures each corresponding with that in the platform, X, fig. 3. These apertures are four feet distant from each other, or two feet each from the centre, so that when the sacking is stretched across, one aperture appears on each cylinder. When the bedstead is preparing for use, care must be taken to have one aperture in the sacking immediately over that in the platform. This will cause more sacking to be on one cylinder than on the other, and it is on that side that the change bedding is to be made up, and which is denoted to the attendant by a red mark on the sacking at the foot of the cylinder when a change of bedding is effected, the other aperture is over the centre and the bulk of sacking is on the opposite cylinder, which is also denoted by the red mark. This is an infallible guide to the attendant to that side on which the change bed is to be made up, for was it to be made upon the wrong side, there would not be a sufficiency of sacking to permit the change to be completed.

For evacuation, the bed or mattress has an aperture in it corresponding with the others. This is closed by a cushion to fit when not wanted, the bed-pan slides under the bedstead immediately under the aperture, X, fig. I. When wanted for use, revolve either cylinder till the patient is placed on his side, the cushion is then taken out, and the body replaced on the back.

Having thus described the nature of my invention, and the manner of constructing and using the same, I would observe that I lay no claim to any of the parts separately of which the apparatus is composed, they being separately well known and in use. I therefore only claim as my invention the application of the above combination of mechanical powers to a new and specific purpose, as herein represented and described, without confining myself to the use of any particular material, or any particular fashion in the construction of the apparatus.—In witness whereof, &c.

Enrolled July 15, 1835.

MAGNETO-ELECTRIC INDUCTION.
BY MR. F. WATKINS.

THE production of motion by magneto-electricity is not new, many philosophers having already suggested and prepared various mechanical contrivances by which a body might be made to move continuously by magneto-electric agency.

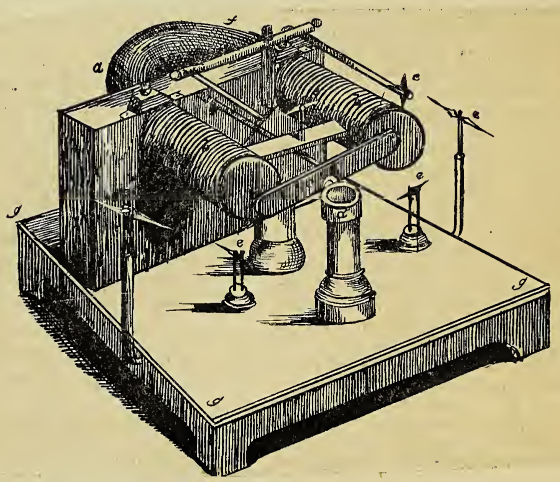
Among the contrivances with which I am acquainted, none can vie, either in simplicity or in beauty of design, with that which emanated from the ingenuity of Mr. Saxton. The instrument as originally constructed by him may be daily seen in operation at the Gallery of Practical Science in Adelaide Street.

Having been, as you know, for a long time extensively engaged in the construction of electro-dynamic and magneto-electrical apparatus, on seeing Mr. Saxton's machine, I, with his permission, immediately commenced making one nearly after his fashion, and afterwards conceived that it might be made to show an increased number of phenomena. Following out my ideas experimentally, I obtained distinct revolutions from eight magnetic needles, together with the vibration of a ninth. I am not aware that a multiplication of motion to this extent has been achieved before; indeed, by applying a second electro-magnet seventeen bodies might be put in motion at the same time, and by a judicious arrangement even more.

The drawing which accompanies this communication represents my apparatus. In arrangement it varies very little from that of Mr. Saxton's, the difference being merely in this respect, that Mr. Saxton places the *axis* which carries his *main* revolving permanent magnet *outside* of the electro-magnet, while my axis is situated *inside*. The only advantage I obtained is that the apparatus is much more compact. Were this all I have to advance on the subject, I should not trouble you with the present communication; but as I have added seven permanent magnets in different situations, and succeeded in obtaining continued rotatory motion in all, I conceive that I have thus rendered the magnetic toy somewhat more interesting.

The revolving magnets I have had in motion for eleven hours without superintendence, and they were only stopped when my workshop was closed for the day. The chemical action on the copper and zinc elements of the voltaic battery employed to induce polarity in the soft iron by means of the copper wire surrounding it, is produced merely by salt and water (not nearly so strong as sea water); and I have a solution of this kind constantly in use, which has been mixed above a month, and when the metallic elements are now placed in it, the magneto-electric machine in question acts without sensible diminution of force.

The pendulum and suspended magnetic needles of this toy at times exhibit in a beautiful experiment of M. Plateau recorded in *Correspondence Mathematique et Physique*, par M. Quetelet, tom. vi. p. 70 (1830).



(*a*). A piece of soft iron bent in the form of a horse shoe magnet, partly surrounded as at *b b* by copper wire covered with silk in the usual manner.

(*c*). A permanent magnetic needle revolving on an axis as represented in the figure, which axis has a contrivance of points dipping successively into a divided cup of mercury, one division of which is in connexion with the zinc element. The cup for the mercury cannot conveniently be shown in this figure, but it is placed so that the points on the axis, which have the effect of changing the current in the copper wire enveloping each arm or branch of the soft iron, may dip into it successively as the axis rotates.

(*d*). A cup of mercury connected with one end of the copper wire coiled on the arms of the soft iron, while the other end of the wire is immersed in a similar cup situated at the other end of the axis, which it was impossible to show in the figure.

(*e e e e e e*). Traversing magnetic needles; two, *é é*, revolve in a horizontal plane, the five former in a vertical plane.

(*f*). A pendulum, consisting of a magnetic bar suspended by one end, which oscillates as already described.

(*g g g*). A mahogany stand or base for supporting the apparatus.*

SAFETY OF LEAD PIPES PROTECTED BY TIN.

(*Extract of a letter from Mr. G. Chilton, dated New-York, June 23, 1834.*)

Dear Sir,—Observing, in a late number, a notice of Ewbank's *patent* tinned lead pipes, and having had many applications for information concerning the danger attending the use of metal pipes for conveying water, beer, cider, &c., I have been induced to subject the pipes of Ewbank to a few trials, for the purpose of ascertaining whether, from the occasional contact of acids, any deleterious solution of lead would attend their ordinary use.

* Abridged from the Philosophical Magazine, No. 38.

It is well known, that the common beer pump, with a leaden pipe, has frequently given to the liquor a dangerous impregnation, especially after remaining stagnant for a time, and the beer in a sour state. The substitution of block tin would remove the apprehension of danger, but its greater price offers a strong temptation to the use of lead. It appears to me that the lead tube lined with tin will answer the ends of cheapness, safety, and durability. I would therefore invite your attention to the following experiments, which, if you think them of any importance to the public, you may insert in your Journal.

Experiments.—Various portions of lead tube, coated, some with pure tin, and others with different alloys of tin and lead, were bent into the form of a semi-circle, and filled with vinegar of different degrees of strength. After standing, some a month, and others six weeks, with occasional disturbance, the clear solutions were tested, first with sulphate of soda, and afterwards with bihydro-sulphuret of ammonia. The application of the first of these tests, namely sul. soda, produced no alteration in any of the solutions, from which it must be inferred that they contained no lead.

The application of the second test produced, as was anticipated, a brown precipitate of sulphuret of tin. In the same manner, two fresh pieces of tube were filled with a strong solution of common salt, which remained in contact for some time. The solutions, when assayed with the same tests, showed that nothing but a little tin was dissolved.

It appears that in all these cases, which I regard as galvanic effects, the tin was the most oxidable metal, although, when not under the influence of polar arrangement and in the open air, lead appears to oxidiate sooner than tin. It is scarcely necessary to remind you that results similar to these were obtained thirty years ago by the celebrated Professor Proust, at Madrid, who undertook for the Spanish Government an extensive series of experiments on the different alloys of lead and tin, with the express view of determining whether the popular prejudices against the coating of copper vessels with an alloy of tin and lead, which is the common practice, was ill or well founded. Nothing can be more satisfactory than the conclusions he drew from his labours, namely that as, in all his numerous experiments, neither lead nor copper were dissolved, there is little reason to fear the solution of lead from the tinning of our kitchen utensils. I may just mention here, that I am in the habit of cleaning out my soda fountain every spring with dilute muriatic acid, which uniformly dissolves the oxide of tin without touching the copper, which I am persuaded will remain as securely as the sheathing copper in Sir Humphrey Davy's great experiment, and for the same reason.—*American Journal of Science and Arts.*

METHOD OF MAKING CAPILLARY TUBES IN METAL.

For gas-burners, for the safe combustion of mixtures of oxygen and hydrogen, and for other purposes, it is often desirable to divide the end of the discharge-pipe into fine capillary tubes, of the depth of half an inch or more. It is difficult and expensive to bore such apertures in a piece of solid metal, and it is hardly possible to be executed at all, if the apertures are required to be of very small diameter.

Two new methods of producing such capillary tubes have been communicated to the Society of Arts—one by Mr. J. Roberts, of Queen-street, Cheapside, and the other by Mr. Henry Wilkinson, of Pall Mall—which are thus described in the last Part of the Society's Transactions:—

Mr. Roberts's Method.

"Mr. Roberts very ingeniously and expeditiously subdivides the end of a metal pipe into small tubes of any required depth, by means of pinion-wire. Pinion-wire is made by taking a cylindrical wire of soft steel, and passing it through a draw-plate of such a figure as to form on its surface deep grooves in the direction of radii to the axis of the wire: the ribs which separate these grooves from one another may be considered as leaves or teeth, and of such wire, when cut into proper lengths, are made the pinions used by watchmakers. Hence arises the name by which this wire is commonly known. If now a piece of this wire be driven into the end of a brass pipe of such a size as to make a close fit with it, it is evident that part of the pipe has thus been subdivided into as many smaller tubes as there are grooves in the wire. By using a draw-plate fitted to make smaller and shallower and more numerous grooves than are required in common pinion-wire, it is manifest that wires or cores may be produced, which, when driven into metal pipes, as already described, will subdivide them into capillary tubes of almost any degree of tenuity."

Mr. Wilkinson's Method.

"In the course of some experiments on artificial light, which I was engaged in about twelve months since, I was desirous of obtaining a great number of extremely minute apertures for a gas-burner; and, finding it impossible, in the ordinary way, to obtain them, a new method occurred to me, which immediately produced the desired effect. I showed it at the time to several eminent scientific men, who were unable to conceive how these apertures were formed; and, as I made no secret of the method, they were equally pleased at the simplicity of the operation; and the specimen herewith sent has been exhibiting at the Gallery of Practical Science for several months. I did not attach much importance to it myself; but, as I do not find that it is at all known, and now think it might be useful in a variety of ways, I have sent it for you to lay before the Society; and

should they be of the same opinion, I shall feel much pleasure in communicating the mode of operation, by which any number of apertures, hardly visible to the naked eye, and of any length (*even a foot, if required*) may be made in any metal in *ten minutes!*

"The process consists merely in turning one cylinder to fit another very accurately, and then, by milling the outside of the inner cylinder with a straight milling-tool of the required degree of fineness, and afterwards sliding the milled cylinder within the other, apertures are produced perfectly distinct, and of course of the same length as the milled cylinder. A similar effect may be produced on flat surfaces, if required."—*Mechanic's Magazine.*

EASY METHOD OF FILLING LONG SYPHON TUBES.

BY WILLIAM FOSTER ESQ.

(From Silliman's American Journal)

The application of the syphon upon a large scale, for the purpose of drawing water from distant places, may not be new; but I do not remember to have seen it in this, or any other country, before I tried the experiment.

The ancients, we know, brought water for the supply of their cities, by means of costly aqueducts, over hills and valleys, without ever using the fountain principle.

Some years ago Mr. Chapman, proprietor of a distiller in Charlestown, requested me to describe my plan for carrying water through a syphon several hundred feet in length, and drawing water from one well into another: and with the instruction I gave him, he employed a plumber to lay a leaden tube of three-quarter inch bore, from a well twenty-five feet deep, several hundred feet distant from the well of his distillery, which was about thirty feet deep, and where he wanted a greater supply of water.

The operation failed. He then came to me, told me that I had led him into an expensive error. I told him that, had he communicated to me this intensions, I would, with great pleasure, have superintended the work; but now, not knowing what defects there might be in the tube, I consented to assist him, but my first essay was uncuccessful.

The power of the syphon to overcome an eminence is limited to about thirty-two feet, answering to the column of water which the pressure of the atmosphere can raise; or that any defect in the syphon, or any air confined in it, would be fetal to its operation. The usual mode of charging a syphon is by exhausting it partially by inspiration at the longer end. But this was not possible with a tube several hundred feet long, and the expense of a pneumatic apparatus, to procure a vacuum, would have been too great; therefore, I had determined to put it in operation by filling it with water, both ends being stopped; this was done by a small branch at the summit of the tube; and, when filled, this branch was well corked, and the cork pressed down hard on the water, so as to exclude all the air at the surface. It was to be apprehended that some undulations might exist in the horizontal part of the tube, and afford a receptacle for air, which would there be confined without a possibility of escaping, and also prove fatal to the success of the experiment; but of this I could know nothing, as I had not seen the tube laid.

In this state of uncertainty, I began the operation, and filled the syphon; but, as I said before, it failed. On the second trial, I observed that, when the syphon was full, the water in the filling branch rose and fell alternately, and so much that as water has but little elasticity, I concluded that there was air in the tube, and it was, therefore, emptied. Then, to charge it anew, and, at the same time, to exclude the air, it was proposed to perforate the lower end of the long branch, at the bottom of the receiving well, with a fork, just above the cork, which closed it. These small holes allowed the air to escape as it was driven before the water, without losing enough water to prevent the filling the tube with ease. Thus was the air excluded, and the syphon put into operation, and continued for a long time, with some occasional obstruction, arising from the smallness of the tube, and the want of water at the source.

I should suppose that there were many situations where water might be brought from one valley to another, over any hill not exceeding thirty-two feet or which could, without too much expense, be reduced to that point, for the purpose of irrigation, or manufacturing. Large quantities of water, as well as small, may be raised by means of iron mains of large dimensions; and the cutting down hills to procure levels, or surrounding them, and thus increasing the length of aqueducts, at a great expense, and loss of water by percolation and evaporation, may be avoided. Mountain swamps may be drained, or any swamps, where a lower level is not too far distant for the place of issue, or even in a level country, provided some vein of loose gravel can be found, into which a place of discharge may be dug below the surface of the swamp. The ingenuity of our countrymen will, I am confident, yet find many other useful purposes to which the principle may be applied.

METALLIC LIGHTHOUSES.

Mr. Samuel Brown proposes employing bronze or cast-iron in the construction of lighthouses, instead of stone. He seems to have made out that a bronze lighthouse would be incomparably cheaper than a stone one, that it would be more secure against dilapidation or subversion by the waves, that the lights would be better protected from the spray by which they are occasionally extinguished, that it could be erected in one-twentieth part of the time, and in situations where a stone structure is impracticable. It has been proposed to place a lighthouse on the Wolf Rock, near the Land's-End, a position where it would be exposed to the most violent storms of the Atlantic: and a plan was drawn up for the purpose by Mr. Stevenson, who holds a high rank in this department of engineering; which plan, Mr. Brown thinks, would require 15 years for its execution, and cost 150,000*l.* Mr. Brown undertakes to erect one of bronze, 90 feet high, which would answer the purpose as well as the stone one of 134 feet, for 15,000*l.* and to complete it in four months.—*Scotsman.*

LONGITUDE AT SEA.

The *Progress*, a journal of Arras, states, that a person residing at Fauquembergue has, after studying for thirty years, discovered the longitude at sea, and formed an instrument which constantly points out and rectifies the ship's course, indicating the longitude and latitude in the chart.——

HISTORICAL RETROSPECT OF THE CAOUTCHOUC MANUFACTURE.

(*Continued from page* 231.)

Hitherto caoutchouc had been supplied entirely form the American continent; but near tne close of the last, or the begining of the present century, it was discovered that several kinds of plants growing in the East, though very different in appearance from the *hevea* of Mexico, afforded the same substance, or one very much resembling it; and hopes were again raised that extensive use might be made of the juice in its fluid state. Mr. Howison experimented diligently with it, and besides making gloves, shoes, &c., a process practised by the Indians of Para, he proceeded to saturate with it loosely woven fabrics, such as Cossembazar gloves and stockings:—

" Having drawn them upon the wax moulds, I plunged them into vessels containing the milk, which the cloth greedily absorbed. When taken out they were so completely distended by the gum in solution, that, upon becoming dry by exposure to the air, not only every thread, but every fibre of the cotton had its own distinct envelope, and in consequence was equally capable of resisting the action of fluid bodies as if of solid gum.

" This mode of giving cloth as a basis I found to be a very great improvement; for, besides the addition of strength received by the gum, the operation was much shortened.

" Woven substances that are to be covered with the gum, as also the moulds on which they are to be placed, ought to be considerably larger than the bodies they are afterwards intended to fit; for, being much contracted from absorption of the milk, little alteration takes place in this diminution of size, even when dry, as about one-third only of the fluid evaporates before the gum acquires its solid form."

From these experiments, Dr, Anderson anticipated immense benefit to our fishing and commercial interests, from the application of the fluid to nets and cordage; and to the arts, from its use as a varnish. Still, however, there remained the difficulty of procuring it in sufficient quantities; partly arising from the distance and wildness of the places which produced it, and partly from the difficulty of preserving it. He, therefore, strenuously urged its cultivation on the coasts of Africa, as the nearest tropical locality. Nothing, however, came of his zealous and wellment efforts.

In Nicholson's translation of " Fourcroy's Chem stry," vol. viii. (1804), we have a long article on this substance; its remarkable fitness to many purposes in the arts is strongly stated, and its uses, as it was then employed, are enumerated; but no better expedient for extending its use is suggested than " to import the juice of the *hevea* with caustic alkali added to it," which prevents the elastic " substance from precipitating;" while it is distinctly said, that " it remains adhesive and viscid in the solutions" in fixed oils—that " when dissolved by the oils of lavender, aspic, turpentine, &c., with the assistance of a gentle heat, the viscid combination remains adhesive, incapable of drying, sticking to the hands, and, in fact, of no utility"—and that most of the varnishes into the composition of which it is made to enter by a mixture of fixed and volatile oils, " have the inconvenience of softening and becoming very adhesive when exposed to the rays of the sun or to heat."

That no further advances had been made up to 1807, is rendered highly probable by the circumstance that no mention of the subject is to be found in the immense collection of scientific notices forming the 2d volume of Dr. T. Young's " Lectures on Natural Philosophy," more than is implied in giving the titles of some of the books we have already quoted. Even the substance itself is rarely mentioned, and then with very different views; while the only notice of water-proof cloth is a repetition of Vauquelin's conjecture, that " the operation was performed by means of soap, glue, alum, and a little sulphuric acid."

No further improvements seem to have been attempted before 1820, the date of the first patent taken out by Mr. Thomas Hancock. It will be observed, that, up to this time, no real progress had been made towards rendering caoutchouc available for popular use, owing, on the one hand, to the impossiblity of obtaining the liquid juice in a proper state, and in sufficient quantities; and, on the other, to the unmanageableness of caoutchouc when it had once become solid.

(To be Continued.)

ON THE MANUFACTURE AND USE OF SOLUBLE GLASS.

(Translated from "Traite de Chimie appliquee aux Arts, par Mr. Dumas," by James Renwick, LL. D., Professor of Nat. Exp. Philosophy and Chemistry in Columbia College, New York.)

Soluble glass is a simple silicate of potassa or soda, which unites perfect solubility in boiling water to some of the general properties of common glass: besides, although the uses to which soluble glass is applied are very different from those of common glass, the study of it will furnish such exact and close analogies to other descriptions of glass, that we are compelled to include it in the group of chemical compounds which they form.

The discovery of soluble glass and of its uses, is due to a distinguished German chemist, from whom we derive all we have to say in relation to it. This glass, when dissolved in water, forms a liquid which may be applied to cloth or wood, for the purpose of rendering them incombustible. In fact, by the evaporation of the water in which it is dissolved, a layer of a substance capable of fusing when heated, is deposited on these bodies, which is capable of protecting them from the contact of air necessary for their combustion.

Preparation.—Soluble glass may be obtained by dissolving pure silea, obtained by precipitation, in a boiling solution of caustic potassa; but, this process, being both inconvenient and costly, cannot be practised upon a large scale.

When sànd and carbonate of potassa are heated together, the carbonic acid is never wholly driven off, except when the sand is in excess; but the whole of the carbonic acid may be expelled by adding powdered charcoal to the mixture, in such proportion that the carbonic acid of that part of the carbonate which is not decomposed may meet with a sufficient quantity of carbon to convert it into carbonic oxide. In this way the silica first forms a silicate in the proportions contained in common glass, and drives off the appropriate equivalent of carbonic acid; then, at a high heat, the rest of the carbonate of potassa is decomposed by the carbon, the carbonic oxide escapes, and the potassa, thus freed, either sublimes, or combines with the glass already formed.

In order to obtain soluble glass of good and uniform quality, certain precautions are necessary. The carbonate of potassa employed, must be purified.* If it contain much chloride of potassium, the product will not be entirely soluble in water, and a glutinous residuum will be left. In addition, the glass will be liable to effloresce. Sulphate of potassa does not produce any bad effect, because it is decomposed by the carbon, when the matter continues sufficiently long in fusion; but without this precaution, the glass will contain sulphuret of potassium, which also has a tendency to efflorescence.

The sand must be pure, or at any rate must not contain any notable proportion of lime or alumina, for these earths render a part of the glass insoluble. A small portion of oxide of iron has no influence on the qualities of the glass.

The sand and carbonate of potassa (pearlash) are taken in the proportion of two of the latter to three of the former, and to 10 parts of pearlash and 15 of sand, 4 parts of charcoal are added. A less portion of charcoal must not be taken; on the contrary, if the form of potash employed be not sufficiently pure, a larger proportion of charcoal may be advantageously employed. This substance accelerates the fusion of the glass, and separates from it all the carbonic acid, of which there would otherwise remain a small quantity, which would have an injurious effect.

In other respects the same precautions that are employed in the manufacture of common glass, are to be observed. The materials must be first well mixed, then fritted, and finally melted in a glass pot, until the mass becomes liquid and homogeneous. The melted matter is taken out of the pot with an iron ladle, and the pot is then filled with fresh *frit*.

Thirty pounds of pearlash, 45 of sand, and 12lbs. of powdered charcoal may be taken for a charge; with this quantity the heat must be continued for 5 or 6 hours.

The crude glass thus obtained is usually full of air bubbles; it is as hard as common glass. of a blackish gray colour, and transparent at the edges; sometimes it has a colour approaching to whiteness, and at others is yellowish or reddish; these are indications that the quantity of charcoal has not been sufficient.

If it be exposed for some weeks to the air, it undergoes slight changes, which rather tend to improve, than injure its qualities. It attracts a little moisture from the air which slowly penetrates its mass, without changing its aggregation or its appearance, it merely cracks, and a slight efflorescence appears at its surface. If it be exposed to heat, after it has undergone this change, it swells up, owing to the escape of the aqueous matter it has absorbed.

In order to prepare it for solution in boiling water, it must be reduced to powder by stampers; if this were not done, it would dissolve too slowly. One part of glass requires from 4 to 5 of water for its solution.

The water is first heated to ebullition in an open boiler, the powdered glass is then added by degrees, and must be continually stirred, to prevent it from adhering to the bottom. The ebullition must be continued three or four hours, until no more glass is dissolved: the liquor will then have acquired the proper degree of concentration. If the ebullition be checked before this state is attained, carbonic acid will be absorbed by the potassa from the air, which will produce an injurious effect; for the same reason, too great a quantity of water must not be employed, for, during the long evaporation which will then become necessary, the carbonic acid of the water will readily combine with the potassa, and cause a precipitation of the silica.

* Pearlash being the purer form, we shall use its name in the practical part.

When the liquor becomes too thick, before the whole of the glass is dissolved, boiling water must be added.

When the solution has acquired the consistence of syrup, and a density of 1.24 to 1.25, it is sufficiently concentrated and fit for use. It is then permitted to rest, in order that the insoluble parts may be deposited; while it is cooling, a coriaceous pellicle forms upon the surface, which after a time disappears of itself or may be redissolved by depressing it in the liquor. This pellicle begins to appear during the ebullition, as the liquor approaches a state of concentration, and may even serve to indicate this state.

When the crude glass is of a proper composition, it contains but a few saline impurities, and no sulphuret of potassium; it may be treated in the way we have described. But if it contain any notable proportion of these substances, they must be separated before it is dissolved; this separation may be effected in the following manner:—The powdered glass, is exposed to the action of the air for three or four weeks, during which time it must be frequently stirred; and if it run into lumps, which will happen in moist weather, they must be broken up. The glass as we have stated attracts moisture from the air, and the foreign substances either separate or effloresce. It then becomes easy to remove them from the glass. It is sprinkled with water, and frequently stirred. At the end of three hours the liquor is removed, it will then contain a part of all the saline impurities, and a little of the silicate of potassa; the powder is again to be washed with fresh water. Soluble glass thus treated, readily dissolves in boiling water, and the solution leaves nothing to be desired.

As soluble glass is employed in the liquid form alone, it is kept in this state for use. To preserve it, no particular care is necessary, as even after a long space of time it undergoes no perceptible change, if the solution have been properly prepared. The only precaution is not to allow air too free an access to it.

A similar product may be obtained by using a carbonate of soda instead of one of potassa. In this case, two parts of the soda of the shops is required for one of silica. This glass has the same properties as the other, but is more valuable in its uses. The solutions of these two kinds of glass may be mixed in any proportion whatever, and this mixture is more serviceable in some cases, than either of them separately.

Properties.—Soluble glass forms a viscid solution, which when concentrated becomes turpid and opalescent; it has an alkaline taste and reaction. The solution mixes in all proportions with water. When the density of the solution is 1.25, it contains nearly 28 per cent. of glass; if the concentration be carried beyond this point, it becomes so viscid that it may be drawn out in threads like molten glass. Finally the liquor passes to the state of a vitreous mass, whose fracture is conchoidal; it then resembles common glass, except in hardness. When the solution is applied to other bodies, it dries rapidly at common temperatures, and forms a coat like a varnish.

Soluble glass, when dried, does not undergo any perceptible change when exposed to the air, and attracts from it neither moisture nor carbonic acid; neither has the carbonic acid of the atmosphere any well marked action on the concentrated solution; but when a current of carbonic acid is passed through the solution, the glass is decomposed, and hydrate of silica deposited. But a weak solution becomes turbid on exposure to the air, and is after a time decomposed wholly. When the glass is impure, an efflorescence is formed after a while, which may be produced either by the carbonate and hyposulphate of potassa, or by chloride of potassium.

Soluble glass dissolves gradually without residuum in boiling water; but in cold water the solution is so slow as to have led to a belief that it does not dissolve at all. It however never becomes entirely insoluble, except when it contains a much larger proportion of silica, or when it is mixed with other bodies, such as the earths, metallic oxides, &c., with which double or triple salts are formed, as is the case in the common glasses.

Soluble glass which has been exposed to the air, and is afterwards submitted to the action of heat, swells and cracks at first, and melts with difficulty. It then loses about 12 per cent. of its weight. It therefore contains, even when solid, a considerable quantity of water, which it does not lose when simply dried by exposure to the air.

Alcohol precipitates it unaltered from its solution in water. When the solution is concentrated, but little alcohol is required for precipitation, and it need not be highly rectified. Pure soluble glass may therefore be easily obtained from an impure solution by the use of alcohol. The alcohol being added, the gelatinous precipitate is permitted to settle; the supernatant liquor is decanted, the precipitate collected, rapidly stirred after the addition of a little cold water, and subjected to pressure. In truth, however, this process is attended with some loss, for even cold water will rapidly dissolve the precipitated glass, in consequence of its minute division.

The acids decompose the solution of glass. They also act upon it when solid, separating the silica in the form of powder.

Uses.—The properties of soluble glass fit it for numerous and varied applications. It has been used in the theatre of Munich as a means of safety from fire.

All sorts of vegetable matter, wood, cotton, hemp, linen, paper &c. are, as is well known, combustible; but in order that they shall burn, two conditions are requisite, an elevated temperature, and free contact of air, to furnish the oxygen necessary for their transformation into water and carbonic acid. When once set on fire, their own combustion develops the heat necessary to keep up the chemical action, provided they be in contact with air. If deprived of such contact, and made red hot, they will, it is true, yield inflammable volatile products, but the carbon which is left will not burn, as it is deprived of air, and thus the combustion will stop of itself. Such is the part which all the

fixed fusible salts are capable of performing, if they be, in addition, composed of substances incapable of yielding their oxygen at a low red heat, to either carbon or hydrogen. These salts melt as the vegetable matter becomes heated; they form upon it a coat impenetrable to the air, and either prevent altogether, or limit its combustion. The phosphate and borate of ammonia have such a character, but they are so readily soluble in cold water, as to be liable to objections which cannot be urged against soluble glass.

Although soluble glass is of itself a good preservative from fire, it fulfils the object better when it is mixed with another incombustible body in powder. In this case the solution of glass acts in the same manner as the oil of painters. The several coats have more body, become more solid, and more durable; and, if the substance which is added be of proper quality, coagulate by the action of fire into a strongly adhesive crust. Clay, whiting, calcined bones, powdered glass, &c. may all be employed for this purpose; but we cannot yet say with certainty which of them is to be preferred. A mixture of clay and whiting appears to be better than either used separately. Calcined bones form with soluble glass a very solid and adhesive mass. Litharge, which, with the glass, makes an easily fusible mixture, does not give a product fitted for coating wood, as the mixture contracts in drying; it therefore cracks, and is easily separated. Flint glass, and crude soluble glass, are excellent additions. The latter ought to be exposed to the air after it is pulverized, in order to attract moisture. If it be mixed with solution, and be then applied to any body whatever, it in a short time forms a coating as hard as stone, which, if the glass be of good quality, is unalterable by exposure, and resists fire admirably.

The scoriæ of iron and lead, felspar, fluor, may all be employed with soluble glass; but experience alone can decide which of these substances is best, and in what proportion they are to be employed. We should advise that the first coat should always be a simple solution of the glass; and that a similar solution be applied over coats composed of its mixture with other substances, particularly when such coat is uneven and rough.

The last named substances form a solid and durable coating, which suffers no change by exposure to the air, does not involve any great expense, and is readily applied. But, in order that it may not fail, particular care is to be taken both in preparing and employing it.

In order to cover wood and other bodies with it, the solution must be made of a pure glass, for otherwise it would effloresce and finally fall off. However, a small degree of impurity is not injurious, although after a few days a slight efflorescence will appear; this may be washed off by water, and will not show itself a second time. When a durable covering is to be applied to wood, too strong a solution must not be employed at first; for in this case it will not be absorbed, will not displace the air from the pores, and in consequence will not adhere strongly. It is a good plan to rub the brush several times over the same place, and not to spread the coating too lightly. For the last coats a more concentrated solution may be employed, still it must not be too thick, and must be spread as evenly as possible. Each coat must be thoroughly dry before another is applied; and this will take, in warm and dry weather, at least twenty-four hours. After two hours the coat appears to be dry, but is still in a state to be softened by laying on another. The same inconvenience will then arise, which occurs when a thick coat of a concentrated solution is applied; the coat will crack, and does not adhere. This, however, is only the case when potassa is the base of the glass, for that formed from soda does not appear to crack.

In applying soluble glass to the wood-work of the theatre at Munich, 10 per cent. of yellow clay (*ochre?*) was added. After six months, the coat had suffered but little change; it was damaged only in a few places, where it had need of some repair. This arose from a short time only having been allowed for the preparation and application of the glass, and they were therefore done without proper attention.

When this mode is employed for preserving a theatre from fire, it is not enough to cover the woodwork, it is also necessary to preserve the scenery, which is still more exposed to danger. None of the methods yet proposed for this purpose appears so advantageous as soluble glass, for it does not act on vegetable matter, and completely fills up the spaces between the thread; it fixes itself in the web, in such a way that it cannot be separated, and increases the durability of the fabric. The firmness which it gives to stuffs does not injure them for use as curtains, because it does not prevent them from being easily rolled. So far as the painting of scenes is concerned, the glass forms a good ground for the colours. To prevent the changes which some colours, Prussian blue and lake for instance, might undergo from the alkaline matter, it will be necessary before painting to apply a coat of alum, and then one of whiting.

There is no great difficulty in applying soluble glass to cloths, still this operation is not so easy as might at first be imagined. It is not sufficient to coat or dip them in the solution; they still require after this operation to be subjected to pressure. This object might perhaps be best attained by passing them between rollers plunged in the solution. When a cloth is only coated with soluble glass, is put into the fire, it will remain incandescent after it is taken out. This is not the case when it has been properly impregnated with the solution. A still better purpose is answered in this case, when litharge has been added to the solution. The stuff in drying yields to the shrinking of the mixture, and becomes inseparable from it, which is the reverse of what happens when it is applied to wood. A single part of litharge in fine powder is sufficient for fourteen parts of concentrated liquor.

Soluble glass is capable of many other applications, and particularly as a cement; for this use it is superior to all those which have hitherto been employed, for uniting broken glass, porcelain, &c.

It may be used in place of glue or isinglass, in applying colours, although when employed by itself, it does not make a varnish which will preserve its transparency when in contact with air.—*Mechanic's Magazine.*

THE

STUDY OF SCIENCE,

A FAMILIAR INTRODUCTION

TO THE

PRINCIPLES OF NATURAL PHILOSOPHY.

As, among our readers, there may be some who have not had opportunities of becoming acquainted with the recent elaborate researches and ingenious speculations of learned men in the several departments of Natural Philosophy, we have determined to devote a certain number of pages monthly, to form a series of lectures in the several branches of science, by way of a familiar introduction to the study of Natural Philosophy with modern discoveries.

GEOLOGY.

Geology is a greek word, compounded of *ge*, the earth, and *logos*, a discourse. While it is obvious that it constitutes a very important and attractive study, it is equally plain that it is attended with considerable difficulties; in consequence, especially of our inability to penetrate far below the surface of our globe, and in fact the restriction of our examinations to only a portion of the land. We stand on the borders of oceans and rivers, or look into ravines, mines, and the clefts of mountains, like insects that skim the surface or pace the rim of a small vessel of water, or traverse the little mole-hill in the foot-path.

We might here advert to some of the systems which have been framed to explain the present appearances of the surface or, as it has been called, the crust of the earth; but statements of this nature will be better deferred till some of the principal facts which have been observed shall have been stated. Great diversities of opinion have prevailed on many points among geologists; and although our knowledge of facts is continually increasing, we cannot be said to have yet advanced beyond the surface of the science.

Naturally, one of the first subjects of remark is the position, relative situation, and general character of the rocks that constitute the structure of the earth. They not only differ from each other in their essential elements, but in their figure, magnitude, and position, as well as in other circumstances. They lie in strata or beds, and layers. The word *stratum*, of which strata is the plural, signifies bed, and is used to express the order of rocks. Hence, when a mountain, or series of rocks, is composed of a similar and undivided mass, it is said to be unstratified; which, however, is comparatively rare. The crust of the earth, regarded as a whole, is disposed in layers or beds of earth, stone, and various materials, and is, therefore, stratified. These strata are, in one respect, regular; in another, extremely irregular. In the order in which they occur, nothing can be more regular; but in the direction or inclination in which they are found, the utmost irregularity prevails.

Before giving a delineation of the order of rocks, we must remark, that, although this exhibits the law or rule as to the succession of strata, they following each other invariably after this manner, yet all are not found in every, or indeed together in any entire series, in any one situation. Many of the particular classes are always absent; and there may be only two or three present. But the law of succession is never violated; that is, those which sustain others are never uppermost and recumbent upon them, and *vice versa*. If one, two, or more of a series is missing, the rest in going downwards are all rocks of the classes below the one in question; or upwards, those which belong to a superincumbent series. In this respect, therefore, there is no confusion.

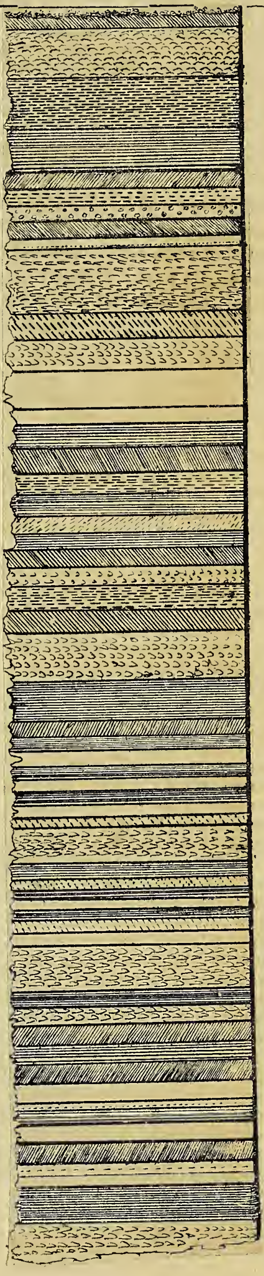
The position of the strata, however, is extremely irregular. Some are horizontal, some almost or quite perpendicular; and the dip or inclination of others is diversified at every possible angle. To a superficial observer, this disarrangement appears accidental, and he is naturally disposed to regard the directions, inclinations, and frequent convolutions of the masses as mere confusion, as if all had been thrown together by some mighty power into a disorderly mass. This very disorder, however, is an unquestionable proof of design and wise superintendence,—a design which pervades the universe as well in its apparent contingencies, as in its most consecutive arrangments and nicest adaptations. If all the strata or layers of rocks on the earth's surface had been placed horizontally one above the other, it is evident that we could only have become acquainted with the superior series; and beds of coal, salt, metals, and other substances which belong to the inferior strata, could never have been available. Upon the supposition, too, that these layers had been wrapped round the nucleus or solid body of the globe like the coats of an onion, the earth would have presented nothing to the eye but a monotonous plain; innumerable varieties of animal and vegetable life could not have existed; and the fertility which now results from the descent of dew, the formation of springs, the gathered

waters of lakes and inner seas, and the flow of rivers, would have been precluded. What modifications of beauty, then, what combinations of utility every where challenge our admiration and love of His wisdom, power, and benignity who governs the universe!

The following sketch represents the manner in which different classes of rocks are disposed.

DIFFERENT KINDS OF ROCKS AND SOILS.

	1.	Vegetable soil
	2.	Sand clay, gravel, with bones of animals of species which now exist
	3.	Deep beds of gravel, large loose blocks, sand, containing bones of extinct animals.
TERTIARY STRATA.	4.	Sand, clay, pebbles, beds of hard white sandstone, many sea shells, bones of extinct animals.
	5.	Alternations of limestones, with fresh-water shells, clays, and limestones containing marine shells
	6.	Thick beds of clay, with sea shells; beds of limestone, extinct species of plants and fruits, land, and amphibious animals.
SECONDARY STRATA.	7.	Chalk with flints Chalk without flints
	8.	Chalk marl Green sand Thick beds of clay Yellow sand, with beds of iron ore Argillaceous sandstone
	9.	Limestones Beds of clay Limestones with corals Beds of clay Thick beds of limestone Thin beds of limestone and slaty clay
	10.	Red marly sandstone
	11.	Limestone containing magnesia
	12.	Coal measures, containing various seams of coal, beds of ironstone, clay, sandstone, and freestones
	13.	Coarse sandstone and slaty clay
	14.	Thick beds of limestone, and slaty clay and sandstone alternately
	15.	Dark red sandstone, with beds of pebbles
	16.	Thick beds of slate and sandstone, occasionally impressions of shells, with thick beds of limestone
PRIMARY STRATA.	17.	Slates and hard rocks alternating, in which no trace of animal remains have been found



(To be continued.)

A POPULAR COURSE OF ASTRONOMY*.

I.

Introduction.

There can have been no period in the history of mankind, in which they did not behold, with a desire to comprehend them, the changes which are daily taking place in the face of the heavens above them; and there can have been none in which they did not perceive these changes to sympathize with others in the surface of the earth around them. He who looks out upon the heavens, beholds a canopy spread forth like the half of a great sphere, of which he appears to occupy the centre. In the day-time, when it is of the colour of azure,—the hue of light in which his perception of its existence is most pleasant to him,—the sun daily takes his course, in a zone, across this fair canopy, "like a giant that renews his strength." As night approaches, the curtain of the heavens gradually loses its transparent azure tint, becomes opaque, darkens, and at length it is black as sackcloth of hair; then come the millions of the stars, and are strewed like gems upon its surface; and in her season the moon walks forth in her brightness, and holds sway amid the dreary watches of the night. These *daily* changes in the heavens appear to have but little relation to the changes of vegetable life, but over the whole of the animated creation their power is absolute. The song of the birds becomes mute at nightfall, and again wakes only to welcome the returning sun. The beast lies down in the forest, the reptile crawls to his lair, and man himself sinks under the mysterious influence of the changing heavens: and returning to that state of oblivion, out of which his birth first brought him, he stretches himself out to sleep. Such is the experience of a day. That of a year brings a still further knowledge of the wonderful sympathy between the changes in the heavens above him, and those in the things around him. He sees the sun not daily to describe the same path in the heavens, but at one time to travel obliquely across them in a higher, and at another time in a lower zone, so as at one time to have a longer course to run, and at another a shorter; and thus at one time to give him a longer, and at another a shorter day. This change in the elevation and consequent length of the sun's oblique path in the heavens, he soon perceives to be coupled with a change in his own perceptions of the intensity of heat and cold; when the sun's path is lowest or most oblique, he is colder than when it is highest. And not only do his own feelings sympathize with this change, but all nature around him. The hand that covered the beast of the forest with a coat of fur, now thickens its garment. The bird, whose path is free in the heavens, now guided by a spark of that intelligence which called it into being, becomes conscious of the existence of a warmer sky in some remote unseen region of the earth, and seeks it. The green herb withers, the blossom dies, the leaf becomes sapless, and falls to the ground. Is it possible, that he who beholds all these changes around him, and who is thus deeply interested in them, who cannot but see that they are all bound together as by a chain, and made to sympathize with one another, should not seek to trace out still more of the mystery of their union, to know more of its nature and laws, and to unravel its cause.

Man is necessarily, and from the very mode and nature of his existence, a speculative being. And of all subjects of speculation, the changes in the heavens are probably those which first arrested his attention. How earnestly must the master spirits of those days, when the secret of the universe was unknown, have wished and have laboured to account for phenomena which we now so readily explain, by means of our knowledge of the form of the earth: how must the mysterious alternation of day and night, and the march of the seasons, have distracted them, wearied their imagination, and perplexed their reasoning.

Quæ mare compescant causæ; quid temperet annum;
Stellæ sponte sua, jussæne vagenter et errent;
Quid premat obscurum lunæ, quid proferat orbem;
Quid velit et possit rerum concordia discors*.

It was in these words that Horace described the sublime but very unsatisfactory speculations of his friend Grosphus.

The mighty changes in the heavens controlling, as they do, all the phenomena of animal and vegetable life, necessarily couple themselves in the mind with the direct agency of the supernatural world, and thus it was that the astronomy of the ancients became incorporated with their mythology. The sky was Atlas or Uranus,—it was eternal and unchangeable; the fixed stars were its organs of vision; the planets, of which the controlling power was the sun, rolled eternally, according to their notion, in concentric orbs of crystal around the earth. These planets they called gods, and their path was along the milky way.

Est via sublimis, cœlo manifesta sereno;
Lactea nomen habet; candore notabilis ipso.
Hac iter est Superis ad magni tecta Tonantis,
Regalemque domum†.

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* This course will be succeeded by similar ones on other subjects.

* "What causes set bounds to the sea, or vary the returning seasons? Whether the stars move of themselves, or by the order of a higher power? What darkens the face of the moon, or extends her to a full orb? what is the nature and power of those principles of things, which, although always at variance, yet always agree?"

† "There is a way in the exalted plain of heaven, easy to be seen in a clear sky, and which, distinguishable by a remarkable whiteness, is known by the name of the milky way. Along this the road lies open to the courts of the nobler deities, and to the palace of the great Thunderer."—Ovid.

They represented them by letters in the order of their distances.

Moon	Mercury.	Venus.	Sun.
A	E	H	I

Mars.	Jupiter.	Saturn.
O	Υ	Ω

Saturn, the slowest of the planets, was taken as the symbol, and made the god of time, and, like time, Saturn destroyed his offspring; he took the *wings* of time and his name, *Chronos.*

Jupiter, the most remarkable of the planets for his splendour, supplanted his father Saturn, occupied the throne of the universe, and became the king of gods.

Mars, of the colour of blood, and placed nearer to the sun, they imagined to be endued with the attributes of a warrior, and called the god of battle.

Venus, whose clear bright light is sometimes to be seen even through the daylight, at one time precedes the sunrise, and at another follows the twilight, alternately pursuing and pursued by the sun. They believed her to produce the fertilizing dews of the morning and the evening; named her the goddess of fecundity, of beauty, and adored her under the names of Astarte, Astaroth, &c.

Mercury, the swiftest moving of the planets, was taken as the symbol of speed and lightness; he became the god of motion; and, being even seen in the immediate neighbourhood of the sun, was designated the messenger of Olympus.

The Sun was adored as the author of light, order, and fecundity; and the Moon, as destined to imbibe this influence from the Sun, in their conjunction, and transmit it to the earth. All the nations of antiquity erected altars to the Sun. In Egypt he was worshipped as Osiris, in Phenicia as Adonis, in Lydia as Athys, &c.

A multitude of divines were thus frequently worshipped in the same being; a fact not to be wondered at, since the attributes which each nation assigned to their common object of worship, would necessarily partake in the errors of their knowledge of it, and the prejudices which they had attached to it. And thus, until it pleased God to make a direct revelation of his will to mankind, the history of the development of the religious principle among them, was little other than a history of the wanderings and uncertainties of the human understanding, which, placed in a world it could not comprehend, sought, nevertheless, with unwearied solicitude, to develop the secret of it, which, a spectator of the mysterious and visible prodigy of the universe imagined causes for it, supposed objects, and raised up systems; which, finding one defective, destroyed it to raise another not less faulty on its ruins; which, abhorred the errors that it renounced, misunderstood those which it embraced; repulsed the very truth for which it sought; conjured up chimeras of invisible agents, and dreaming on, without discretion and without happiness, was at length utterly bewildered in a labyrinth of illusions.

How great is the contrast! Since the age in which the heathen mythology had its origin, the religion of mankind has fixed itself upon the sure foundation of a revelation from God, and the human understanding has acquired for itself the master-secret of the universe. The wanderings of the stars on the firmament of the heavens are at length understood. The question,

Sponte sua jussæne vagenter et errent?

no longer perplexes us. We find throughout the whole of what appeared to our ancestors the capricious motions of powerful but isolated beings, evidences of one impulse, one will, one design, one Almighty power, originating, sustaining, and controlling the whole. These beings then, to whom, calling them their gods, it was natural that they should attribute a separate, independent, and capricious existence, subject to the indecision, the error, and the feebleness of humanity, appear to us but as the creatures of one sovereign intelligence, bound down in as passive obedience to that intelligence, as the stone that falls from the hand, or the apple that falls from the tree; with no other thought, or will, or power, than that of any particle of duct blown about by the Summer's wind. Thus the whole of the sublime and gorgeous pageantry of the heathen mythology vanishes like the baseless fabric of a dream.

We know that this magnificent phantom retained its shadowy control over the intellect of man, in an age of great literary refinement, of profound knowledge in the philosophy of morals, and of high civilization; and had no revelation interposed, there could be nothing found in the mere literature, ethics, and civilization of *our* day, as distinguished from the literature, ethics, and civilization of theirs, to overthrow it; thus we might still, in respect to these, be what we are, and yet the worshippers of a host of gods: but combine with these the *science* of our times, and the supposition becomes impossible; a single ray penetrating the mystery of the universe is sufficient to dispel the illusion of Polytheism, and instruct us in the knowledge of the one only and true God.

How prodigious has been the progress which the universal mind of man has since made, how wonderful the vantage ground on which *we* stand, when we look forth upon nature; the human intellect now walks to and fro in creation, as with the strength of a giant, the growth of whose stature has been through ages, and who but yet approaches the noontide of his vigour.

The first question which suggests itself to a mind curious to understand the phenomena of the heavens, is probably this—are the sun, moon, planets, and stars, really as they seem to be, at the same distance from us, and almost within our reach? or are they, as we are told, some of them infinitely more remote from us than others; and the near-

est of them distant more than half a million of miles? Our first inquiry shall then be,

What is the probable Distance of the fixed Stars?

Are they, as we are told, many millions of miles away from us; so far, indeed, that their light, travelling as it does at the rate of 80,000 leagues in a second, has from the nearest been six or eight years in reaching us? And if it be so, how is this known?

Let us suppose an observer to have travelled about, far and wide, on the earth's surface, and accurately to have observed, as he went on, the appearances of the heavens; he will at once have perceived the stars to be bodies scattered about in that great space, whatever it may be, which contains the earth, and he will have remarked that they do not alter their apparent relative positions, as he moves about on it. Their apparent positions, with regard to the *horizon*, are, indeed, continually altering; but with regard to one another, he finds them always the same. This will appear to him very extraordinary, when he considers that the various objects around him on the earth's surface, are continually subject to apparent changes of relative position, as he moves about from one place to another. Thus for instance—let him be sailing along the sea-coast at night, and let him observe two lights upon projections of the shore. At one instant, when he is in the line joining the lights, they will appear to him to coincide, blending momentarily into one light; as he proceeds, they will appear to separate, or, in the nautical phrase, they will *open;* and this opening of the lights will continue, until they have at length acquired a certain maximum apparent distance. They will then appear to approach one another; and, as he finally leaves them behind him, they will go through all the same circumstances of apparent motion as attended his approach to them. If the lights be sufficiently remote, all these changes in their apparent distance from one another, will be referred to, and apparently take place upon, the circular margin of the horizon. They will seem like two beads of light moving towards one another on the *circumference* of that circle; coinciding, then receding, and again approximating to one another. These apparent motions are called parallactic.*

(*To be continued.*)

* *Parallax*, the angle formed by two different lines of view drawn towards one and the same object. Suppose a point is seen from the two ends of a straight line, the two lines of view towards that point form, with the first line, a triangle, whose angle at the point seen is the parallax, or parallactic angle. *Annual parallax* - the angle formed by two lines from the ends of one of the diameters of the earth's orbit to a fixed star, which angle, on account of the immense distance of the fixed star, is too small to be observed.

CHEMISTRY.

THE WONDERFUL AND SUDDEN TRANSFORMATIONS WITH WHICH CHEMISTRY IS CONVERSANT, THE VIOLENT ACTIVITY OFTEN ASSUMED BY SUBSTANCES USUALLY CONSIDERED THE MOST INERT AND SLUGGISH, AND, ABOVE ALL, THE INSIGHT IT GIVES INTO THE NATURE OF INNUMERABLE OPERATIONS WHICH WE SEE DAILY CARRIED ON AROUND US, HAVE CONTRIBUTED TO RENDER IT THE MOST POPULAR, AS IT IS ONE OF THE MOST EXTENSIVELY USEFUL, OF THE SCIENCES; AND WE SHALL, ACCORDINGLY, FIND NONE WHICH HAVE SPRUNG FORWARD, DURING THE LAST CENTURY, WITH SUCH EXTRAORDINARY VIGOUR, AND HAVE HAD SUCH EXTENSIVE INFLUENCE IN PROMOTING A CORRESPONDING PROGRESS IN OTHERS.—*Sir John Herschel on the Study of Natural Philosophy.*

Chemistry is the art wherby compound bodies are changed into simple ones, or simple bodies into compounds. The former of these processes is called Analysis or Decomposition, and the latter Synthesis or Composition. As a science, it is the province of Chemistry to determine the chemical relation of simple bodies, and the structure and chemical relations of compounds. Few of the operations of Chemistry, which are employed for the attainment of these objects, are either purely analytic or synthetic; a combination of these methods generally taking place in the processes of the chemist.

Different kinds of matter, which are the objects of Chemistry, possess certain active properties, such as gravity or weight, cohesion, elasticity, expansibility, magnetic attraction, &c. All these properties are but so many different modifications of attraction and repulsion. Action, either attractive or repulsive, takes place between bodies situated at various distances from each other. Thus the attraction of gravitation operates at indefinite and immense distances; while the attraction of cohesion affects the particles of bodies only when placed in apparent contact. Repulsive action also takes place at different distances. Thus, the repulsion between bodies which have been subjected to the influence of electricity or magnetism is sufficiently obvious to the sight; and that electric or magnetic substances, which repel each other, do not touch, may easily be perceived. The expensive power of heat, on the other hand, probably affects particles of matter nearly in contact with each other.

The various phenomena which constitute the objects of Chemistry, depend on the operation of those modifications of attractive and repulsive force, which act on particles of bodies placed at insensible distances from each other, and are so minute as not to be cognizable by our senses, even when assisted by the most powerful magnifying glasses.

There are two species of attraction which affect particles of matter when in apparent

contact: 1. The Attraction of Aggregation, or Cohesion; 2. The Attraction of Composition. These powers both give way to the repulsive action of heat: but the former may also be overcome by mechanical force, which has no effect on the latter.

The Attraction of Aggregation operates differently on different bodies, so as to produce the various degrees of cohesive force or consistence observable among them. The forms under which bodies appear are reducible to three classes, namely: Solids, Liquids, and Gases or Airs. These modifications of matter are influenced by the operation of mechanical pressure and the expansive force of heat, which seem to act as antagonist powers to each other. Some kinds of matter are capable of existing either in a solid, liquid, or gaseous state, under different degrees of atmospherical pressure and temperature. Thus, water, by the abstraction of heat, becomes changed to ice; by the addition of heat, it is, on the other hand, changed to vapour; and that change is facilitated or impeded by lessening or increasing the atmospherical pressure. Mercury and several other substances exhibit analogous phenomena.

Many bodies, however, commonly exist under only one or two forms of aggregation. Common air and other bodies, distinguished from vapours by the designation of permanent gases, were formerly supposed to retain the gaseous form under all circumstances; but from the experiments of Dr. Faraday and Mr. Perkins, it appears that atmospheric air, carburetted hydrogen, sulphuretted hydrogen, sulphurous acid, carbonic acid, protoxide of chlorine, nitrous oxide, cyanogen, ammonia, muriatic acid, and chlorine, all which, under common temperatures and pressures, are permanent gases, may be condensed to the liquid state by the joint operation of intense cold and powerful compression. However, oxygen, hydrogen, and some other gases have hitherto resisted all attempts to reduce them to the liquid state.* Several dense solids, as lead and glass, are readily melted by heat; but there are others, as wood, which, though speedily decomposed, when heated with access of air cannot be liquified. The facts already stated, and others which might be adduced, still lead to the conclusion that the solid, liquid, and gaseous states of bodies depend chiefly on their respective relations to temperature and pressure; and, therefore, the distinctions founded on those states or forms of matter do not furnish sufficient grounds for general arrangements of bodies in separate classes.

Some writers have treated of the chemical properties of gases or airs as an independent branch of science, under the appellation of Aërology; but the operation of bodies under their different forms are so intimately blended, and the condensation of gases is so commonly the effect of chemical combinations, that it seems by far most convenient not to separate Aërology from Chemistry, but to regard it as a subordinate section or subdivision of chemical science.

*See *Pneumatics*, part ii. p. 10.

In solid and liquid substances, the powers of attraction and repulsion counterbalance each other: while the latter predominates in gaseous bodies. Some have supposed solidity to result from the preponderance of the force of attraction over the force of repulsion; but this opinion seems incompatible with the well known fact of the expansion of water when it becomes solid. This, and some other phenomena of a similar description, clearly show that the action of a repulsive force is not less obvious in solids than in fluids. They probably differ more in the arrangement of their particles, than in the manner in which those particles are united.

The peculiar province of Chemistry, as might be inferred from the preceding observations, is the study of the Attraction of Composition, or the investigation of the properties of bodies, not as respects their organization, mechanical construction, form, or consistence, but with a view to the discovery of ther molecular composition, or the nature and mode of union of their component particles. Hence, there must necessarily be a wide distinction between mechanical and chemical combination. Any substances may be mechanically combined by mere mixture, which occasions no destruction or essential alteration of the sensible properties of the mixed bodies: for the compound formed by the union of two or more substances which have no chemical action on each other, will always exhibit their joint properties, modified, perhaps, but not destroyed by their commixture. The effect of chemical combination is very different, for bodies chemically united often become completely deprived of the peculiar properties they previously possessed, and manifest new and sometimes very extraordinary powers, totally different from those of their constituent parts.

"If water be added to water, or salt, the effect is an increase of quantity, but no change of quality. In this case, the mutual action of the particles is entirely mechanical. Again, if a blue powder and a yellow one, each perfectly dry, be mixed and well shaken together, a green powder will be produced; but this is a mere effect arising in the eye, from the intimate mixture of the yellow and blue light separately and independently reflected from the minute particles of each; and the proof is had by examining the mixture with a miscroscope, when the yellow and blue grains will be seen separate, and each quite unaltered. If the same experiment be tried with coloured liquids, wich are susceptible of mixing without chemical action, a compound colour is likewise produced, but no examination with magnifiers is in that case sufficient to detect the ingredients; the reason obviously being, the excessive minuteness of the parts, and their perfect intermixture, produced by agitating two liquids together. From the mixture of two powders, extreme patience would enable any one, by picking out with a magnifier grain after grain, to separate the ingredients. But when liquids are mixed, no mecha-

nical separation is any longer practicable; the particles are so minute as to elude all search. Yet this does not hinder us from regarding such a compound as still a mere mixture, and its properties are accordingly intermediate between those of the liquids mixed. But this is far from being the case with all liquids. When a solution of potash, for example, and another of tartaric acid, each perfectly liquid, are mixed together in proper proportions, a great quantity of solid saline substance falls to the bottom of the containing vessel, which is quite different from potash or tartaric acid, and the liquid from which it subsided offers no indications by its taste, or other sensible qualities, of the ingredients mixed, but of something totally different from either. It is evident that this is a phenomenon widely different from that of mere mixture: there has taken place a great and radical change in the intimate nature of the ingredients, by which a new substance is produced which had no existence before; and it has been produced by the union of the ingredients presented to each other, for, when examined, it is found that nothing has been lost, the weight of the whole mixture being the sum of the weights mixed. Yet the potash and tartaric acid have disappeared entirely, and the weight of the new product is found to be exactly equal to that of the tartaric acid and potash employed, taken together, abating a small portion held in solution in the liquid, which may be obtained, however, by evaporation. They have, therefore, combined, and adhere to one another with a cohesive force sufficient to form a solid out of a liquid; a force which has been called into action by merely presenting them to each other in a state of solution."*

As it is the object of Chemistry to determine the composition of different substances, therefore, if we could reduce all bodies to their elementary principles, and discover the proportions in which these principles must be combined in order to recompose such bodies, the science of Chemistry would be complete. This, however, is far from being the case, notwithstanding the extraordinary discoveries that have rewarded the labours of those philosophers who have paid attention to this important branch of knowledge. But though we allow that much remains to be achieved by future experimentalists ere Chemistry can be said to make any near approaches to perfection, yet it must be admitted, that the improvements which have taken place in this science in our own times are of no common importance, since its first principles have been fixed on the firm basis of experiment, and a luminous system, founded on facts, has superseded those obscure and hypothetical speculations which occur in the writings of the older chemical authors.

Among the most important discoveries of modern philosophers, we may reckon those which relate to that inherent tendency which matter possesses to form new combinations. This property of matter gives rise to many of those operations of nature which we view without surprise, only because they are common; and it is not less concerned in several of the most striking and extraordinary phenomena of nature and art. Thus, when we procure light or heat by burning any combustible substance, as, for instance, wood, chemical action takes place between the inflammable matter contained in the wood, and part of the air of the room in which the wood is burned; in consequence of which, a new kind of air is formed, the greater part of which flies off with the smoke. The respiration of animals affords another instance of chemical action. When air is taken into the lungs, a part of it combines with something which separates from the blood; in consequence of which combination, the air becomes altered in its properties, as must be obvious to every one who considers that the atmosphere of a crowded apartment, not properly ventilated, is soon rendered so noxious as to occasion considerable inconvenience, and even faintness, to those whose constitutions are delicate.

On taking a survey of the various bodies around us, we may observe that some among them, which we reckon inert, because from the influence of habit, or other causes, they make but a slight impression on our senses, are yet endowed with active powers or properties, which render them capable of producing remarkable changes in other bodies. Thus, water, which is insipid to the tongue, and which, in its operation on living animals and vegetables, acts slowly and almost imperceptibly, will yet, if placed in contact with a lump of salt or sugar, speedily reduce either from the solid to the liquid state. Atmospheric air, though it is necessary for the support of animal and vegetable existence, and gives rise to scarcely any sensations but such as depend on variations of temperature, yet this widely extended gaseous body, by its union with other substances, sometimes produces the most striking phenomena. Thus, the explosion of fire-damp in coal-mines can only happen when the inflammable gas, so called, is mixed with a certain portion of common air.

One of the most obvious modes of distinguishing bodies is that which depends on their different degrees of density; whence the arrangement of substances into the respective classes called solids, liquids, and gases, already noticed. But these distinctions cannot be advantageously employed as the basis of a chemical classification of natural bodies, for reasons which have been already stated. Hence, some other mode of discrimination and arrangement becomes requisite, and such a one may be most properly derived from considering the chemical relations of different kinds of matter, and the products derived from their action on each other.

There are some bodies which, by no known mode of treatment without addition, can be made to form more than one species of matter; for, however they may be divided, or subdivided, each particle still possesses the

* Herschel's Discourse on the Study of Natural Philosophy, pp. 297, 298.

same chemical properties with the common mass from which it was taken. There are comparatively but few bodies presented to us by nature in this isolated state; among the number may be mentioned, as examples, gold and the diamond. These, together with all other hitherto undecomposed bodies, must, in the present state of chemical science, be considered as elementary or simple substances. Were it practicable to procure and exhibit all the elements of bodies in a detached form, and to trace the various compounds resulting from their union, Chemistry would have attained perfection, and no object of inquiry would remain for future experimentalists. But notwithstanding the great acquisition of knowledge derived from the discoveries of our contemporaries, they have, by no means, enabled us to determine the boundaries of the field of science, but merely to form some conjectural ideas concerning its vast extent.

No correct general knowledge of the nature and properties of different substances can be acquired without instituting comparisons between them, whence we may discover the various points of similitude or contrast among them, which will enable us to arrange them in groups or classes, bearing certain relations to each other.

For the purposes of chemical inquiry, the most obviously convenient arrangement of bodies is that in which they are classed according to their composition, placing the simple bodies first in order, and then the compounds arising from the various combinations of the former.

According to the ancient philosophers, the simple bodies or elementary principles from which all the varieties of matter are composed, were but four, namely, Fire, Air, Water, and Earth. This notion, after having for ages formed a part of the creed of the learned, has been completely exploded by the light of modern science, though it is not yet extinct among the vulgar. The alchemical writers of the middle ages added to these principles some others, as Salt, Sulphur, and Mercury; to which terms, however, they attached ideas very different from those that belong to them at present, and into the nature of which we shall not stop to inquire.

Some of the alleged elements of the older chemists are now known to exist only in imagination, and others are ascertained to be, by no means, simple substances; thus, Air is found to consist of two different elastic fluids or gaseous bodies, which may be seperated by various processes, and exhibited apart from each other. Water, also, has been ascertained to be a compound which may be analyzed or decomposed, so as to produce two distinct kinds of gas, which may be separately collected; and when again mixed together in proper proportions, they may be made to form water by their union.

Other bodies, formerly esteemed simple, have yielded to the analytical processes of modern chemistry; but there is a certain number of substances, which, either in the state in which they are presented to us by nature, or as they are procured in various operations by art, have hitherto resisted all attempts at farther decomposition, and which, therefore, as before stated, must be regarded as simple substances. Their number is not very great, amounting to about fifty-four, and it is not unlikely that the future researches of chemists may demonstrate some of these bodies to be compounds; at the same time, it is probable that additions may be made to the class of elementary substances in consequence of future discoveries, several of those now admitted into this class having become known to us but very recently.

Some of these elementary bodies are widely and abundantly dispersed throughout the three kingdoms of nature, either alone or in a state of composition, while others appear to be of very rare occurrence, or, at least, they have hitherto been met with only in small quantities and in a few situations. The whole of the elementary substances may be arranged in two divisions: the first comprehending those which are not of a metallic nature, the entire number of which now known amounts to only thirteen; the remaining forty-one elementary bodies are all regarded as metals, though some of them exhibit properties differing considerably from those which characterize gold, silver, mercury, lead, iron, and other bodies, to which the designation of metals was originally applied.

(To be Continued.)

ELECTRICAL THEORY OF THE UNIVERSE. BY MR. THOMAS S. MACKINTOSH.

Continued from page 225.

Development of the Theory of the Solar System.

1. Centre of Positive Electricity.—The body of the sun has a powerful affinity for electricity, and is intensely charged with electric fluid; and is surrounded with an atmosphere of electricity extending to the utmost limits of the planetary system, decreasing in density in a certain unknown ratio with its distance from the sun. The sudden appearance and disappearance of spots on the sun's disc affords proof, even to demonstration, that the elementary matter of the sun is, at intervals at least, in a state of violent commotion; and when we consider that some of these spots are much larger than the earth, how vast must be the effort to cause them to appear and to disappear in so short a space of time as they have been known to do! There is no known agent in nature capable of producing such vast results except electricity; and this consideration alone almost forces the conclusion upon us, that the sun is an immense spherical conductor, highly charged with electric fluid. "The light obtained by voltaic electricity exceeds in intensity any other that art can produce; it is so dazzling as to fatigue the eye even by a momentary impression; it is a light which so nearly emulates the sun's rays, as to be applicable

for the purpose of illuminating objects in a solar microscope. All this accords with the light of the sun." We will not discuss the point as to how the voltaic light is evolved, since, whatever may be the nature of the process, it appears that the presence of electricity is essential to its exhibition. We are, therefore, justified in the conclusion, that as both lights have some properties in common, they are to a certain extent identical. If this conclusion be correct, it might be supposed that we should be enabled to detect electricity in the sun's rays. In the *Journal des Progres des Sciences,* this is said to have been effected by Professor Salvenio Barlocci, of Rome, who states, that when two pieces of copper, painted black, one of them connected with the upper part of a frog, and the other with the hind feet, were placed one of them in the red and the other in the violet ray of the solar spectrum, and then brought in contact, that contractions took place in the muscles of the frog. This seems to indicate very pointedly the existence of a certain specific modification of electricity in the sun's rays ; and if in the rays proceeding from the sun, the conclusion that the sun is highly charged with electricity becomes irresistible. Although light and heat may be, to a certain extent, connected with our subject, we will pass them over for the present, as their consideration would lead us into too wide a field and create confusion. We wish to consider the sun simply as the prime, positive, electrical conductor of the solar system ; and with a view to fix this idea permanently in the mind of the reader, we have denominated him the "centre of positive electricity."

2. Region of Negative Electricity.—That part of space which surrounds the solar system on every side beyond the range of the planets, we shall denominate the region of negative electricity. We shall assign no properties whatever to this region, unless vacuity may be considered a property, not a perfect vacuum, but nearly so, and especially as regards the electric fluid; it will, therefore, have a powerful attraction for electricity, which however, it cannot retain, for two reasons:—1. This region contains no substance upon which the electric fluid can fix; this is evident to the senses, for if the immense space between the earth and the fixed stars were filled with any substance but the most subtle ether, it would be utterly impossible that the stars could be seen. 2. There are strong reasons for the assumption, that all matter issuing from the sun becomes decomposed in this region, or undergoes some specific change, and returns to the sun under its new modification. That this process must be continually going on is evident, otherwise even the immense bulk of the sun must have been dissipated long ere this time, from the vast volumes of matter continually issuing from his surface. We consider, then, that this space is in a state of negation as regards the electric fluid, and, therefore, has a powerful attraction for electricity. An objection may be raised to this assumption, upon the ground, that as this region is alleged to contain no matter upon which the electric fluid can fix, it cannot, therefore, be supposed to attract electricity ; but since we know from experiment that the more the air is rarefied, the less resistance is opposed to the passage of electricity, and that there is a constant tendency in the fluid to escape from the charged body, as is evinced by its distribution in the surface—it may be conceded, that this region offers facilities to the ready dispersion of the electric fluid from the charged body, and this concession is all that is required.

3. If we regard the sun as the prime positive conductor of the solar system, very intensely charged with electricity, it will not be difficult to conceive him capable of emitting a body of vapour containing a much larger quantity of matter than any comet or planet in the system. If we consider that the sun is more than a million of times larger than the earth, the emission of a comet may be regarded merely as a spark drawn from the prime-conductor : comets of great brilliancy have been observed receding from the sun, whose approach to that body had not been detected by diligent observers ; in the absence of direct proof, this circumstance alone is almost sufficient to justify the inference, that that body had just commenced its long and unwearied journey around the solar system. We might refer to volcanic eruption in the earth in support of this hypothetical proposition; but when we consider the vast concentration of electrical power in the sun, and refer it to the comparatively feeble efforts of volcanic fire, the illustration is too faint to convey an adequate idea of the force of electrical action. An evidence of violent internal commotion is furnished by the immense moving spots that have been observed on the sun's disc ; and we know that in all the natural phenomena that come under our immediate observation, if there is violent internal action, there is a constant tendency in the excited body to relieve or deliver itself of a portion, at least, of the exciting cause of the commotion. There is nothing extravagant then in the assumption, that comets are discharged from the sun : the supposition is in perfect accordance with the known phenomena of nature, and entirely within the range of natural probabilities.

4. If the sun were in a state of rest, a comet would be projected in a straight line, but as he revolves on his axis with great rapidity, it is projected in a curve, which is the beginning of a circle, that is to be described by the comet in all its future revolutions around the solar system. If we might be permitted to use a homely illustration, that should bring this idea clearly within the conceptions of minds of the humblest capacity, we should say, that a comet is projected from the sun somewhat in the manner that sparks are emitted from the surface of a knife-grader's wheel. As the projectile force is greater than that derived from the sun's rotary motion, the elliptical form of the comet's orbit is determined by the two forces conjointly in a ratio corresponding with the force of each respectively. Now as the sun and comet are both highly charged with positive electricity, it follows from the esta-

blished law that two positive bodies repel each other, that the comet will be repelled with a velocity corresponding with the intensity of the charge in each of the two bodies, and as negative and positive bodies attract each other, it will be attracted with an equal power into the region of negative electricity; but as the attractive power of this region is equal on all sides, the comet will not be attracted to any given point, but will follow the original curvature of its orbit first imparted upon its emission from the sun; as the comet penetrates into the region of negative electricity, its charge will be gradually withdrawn or dissipated; and as this process proceeds, the velocity with which it moves must necessarily decrease, and, at a certain point, the attractive and repulsive forces must be in equilibrio, until at length the whole, or nearly the whole, of the charge is withdrawn, and the comet being now negative, is attracted by the sun, and repelled by the region of negative electricity. As the nucleus and materiel of the comet has a strong affinity for the electric fluid, as it approaches the denser part of the sun's electric atmosphere, it will imbibe the fluid, and, consequently, cannot enter into the body of the sun, but will be again repelled in an orbit less elliptical than that described in its first revolution. In order to form a competent conception of the manner in which this effect is produced, we must refer to the electrical phenomena exhibited by a stream of electricity in its passage between the two points of a positive and negative conductor: here we perceive, that "the velocity will carry the particles that have deviated from a direct course somewhat beyond the point to which they are attracted; while the attraction to this latter point will tend to deflect them from the line of their path, and gradually turn them back, so that they will arrive at the point of attraction by a retrograde motion." Now as the deflection must necessarily correspond with the size of the point of attraction, and as the sun is a body of immense magnitude, it follows that the comet will be deflected in its path in a curve corresponding with the circle of the sun's electrical influence; and as the repulsion between the sun and comet is an increasing force at the period of the latter's perihelion; and as this repulsive force is exerted equally on all sides of the sun, a portion of this force must press laterally on the comet in its orbit, thereby tending to widen the ellipsis. This part of our theory derives a support almost amounting to demonstration, from the fact that "when comets first make their appearance, they generally resemble a round film or vapour, with little or no pretensions to a tail, but they increase in brilliancy and the acquisition of a tail as they draw near to the sun; but it is after they have passed their perihelion, when emerging from the brilliancy of the solar light, in which they have been for a short time obscured, that they assume their greatest splendour; the tail which, during the approach to the perihelion, had followed the comet, now precedes it generally with a small degree of curvature, probably arising from the resistance of the ether, which is supposed to pervade all space." The increased brilliancy must be ascribed to the increased quantity of electric fluid that the comet has imbibed in its passage near the sun; and the tail being projected from the sun, is plainly to be referred to the repulsive force exerted between two bodies both positively charged, or, perhaps, with more strict propriety, to the inductive influence of electricity, repelling and concentrating the electric fluid in the remotest part of the comet's tail. Now as the comet cannot be so highly charged by passing through the electric atmosphere as when first disengaged from the sun, it follows that the repulsive power is weaker, and that, consequently, it will not be projected to the same distance as in its first revolution. From these considerations we draw this conclusion, that in the course of "series of revolutions, the orbit of a comet becomes less elliptical; its projected distance from, and its approximation to, the sun becomes less in nearly an equal ratio." We must further observe, that during the cometary state, the materiel of the comet undergoes certain specific changes relative to its electric functions; the tail is gradually absorbed by the nucleus, and when its orbit is reduced to the planetary form, it takes its station in the exterior circle of the planets, a well-matured and compacted body, a fit recipient and supporter of vegetable life.

5. We have laid it down as a fundamental law in this theory, that the earth and all the planets of the solar system are maintained at their respective distances from the sun, and each other by the relative proportions of positive and negative electricity with which each is charged; and we further assume, that the positive charge is a continually decreasing quantity from the time of a comet's first emission from the sun, until it finally falls back into that body a worn-out and exhausted planet. We have no data whatever which would enable us even to attempt to fix the time occupied in accomplishing these vast operations of nature, each specific change in bodies of such immense magnitude must require periods of vast duration; compared with which, the age of human records is but as one day. We are assured by experiment, that the attractive and repulsive forces of electricity follow the same law as to its intensity, that is, the inverse ratio of the square of the distance. Let this be compared with the laws of Kepler, and we think the conclusion cannot be resisted, that the motions and distances of the planets are regulated and determined by this powerful and all-pervading agent. If we endeavour to estimate by the operations of sense the manner in which the planets are said to be propelled in their orbits with such amazing velocity, we feel a difficulty in perceiving the cause of motion—the effect is admitted, but the cause is not discernable; but if we refer all motion to the agency of electricity, the cause and effect are joined before our eyes; we refer it to an ever-active and known power, appreciable by the senses, pervading all known space, and whose rapid motion corresponds with the motion of the heavenly bodies; and if we allow the assumption, that the quantity of positive electricity with which the earth and all the planets is

charged, is a continually decreasing quantity, the cause of motion in their orbits becomes plain and palpable; they are in effect attracted and repelled down an inclined plane by the power of electricity.

6. Earth's Motion on its Axis.—Hitherto we have referred all motion to the agency of electricity, as it is developed and exhibited by the excitation of electrics; but that we may be enabled to discern clearly the cause of the earth's motion on her axis, we must refer to the galvanic circle, a clear conception of which is necessary to a right understanding of this part of the theory, Now we hold, that the crust of the earth, sea, and land, is nothing, more or less, than a galvanic circle, or, perhaps, more correctly, a series of circles, or rather a voltaic battery; but we wish to preserve the idea of the simple circle, because it furnishes us with a more clear and distinct explanation of the cause of the earth's motion on her axis than the voltaic pile. We assume, then, that there is a continuous stream of galvanic electricity circulating throughout the earth's external crust, and that the main current is round the equator; that the earth's inclination to her orbit is determined by the direction of this current, and that it has more influence in raising the temperature of the climate within the tropics than that exerted by the sun's vertical rays. Now, it is evident, that if the galvanic circle were undisturbed, the fluid would continue to flow around the earth, and the earth would remain at rest; but the inductive influence of the sun destroys the equilibrio, and the earth revolves. So satisfied are we of the truth of this part of our theory, that we feel convinced that if a sphere were mounted upon two centres, with a galvanic circle formed round its equatorial circumference, correctly balanced, and placed in a proper position between a positive and negative conductor, highly charged, the sphere would be found to revolve so long as the galvanic action continued. And so long as the galvanic action continues in the earth, she will revolve upon her axis, and no longer. Upon this principle we assume, that the galvanic action in the moon has ceased altogether, or become so weak that the current cannot overcome the power of the earth's induction; and as the planet Jupiter turns on his axis in ten hours, whilst Mercury requires twenty-four hours, we infer from this that Jupiter is a good conductor of galvanic electricity, whilst in Mercury the fluid flows with more difficulty.

7. We have assumed that the qnantity of positive electricity with which the earth and other planets is charged is a continually decreasing quantiy. Before entering upon this proposition we would solicit attention to the following:—*If there could exist a power having the property of giving continual impulse to a fluid in one constant direction, without being exhausted by its own action, it would differ essentially from all the other known powers in nature, all the powers and sources of motion with the operation of which we are acquainted when producing their peculiar effects, are expended in the same proportion as those effects are produced.* Now we have laid it down as a fundamental law in this theory, that all motion is effected by the agency of electricity, and that the processes of vegetation, oxidation, and vitrification, and other processes respectively, are carried forward and effected by specifically distinct modifications of the electric fluid. The effect of electricity in quickening the process of vegetation has been repeatedly verified by experiment, and is, therefore, to be considered as an established fact in science. If a plant contained in a pot be subjected to the influence of electricity, the growth will be quickened, and the plant will arrive sooner to a state of maturity; on the other hand, if the plant be secluded from the influence of the sun's rays, and otherwise insulated as much as possible from the electric influence, it is found that it cannot be brought to maturity by the most careful and elaborate processes of art. So essential is electricity, like a quickening spirit, in laborating and perfecting the process of vegetation. The powerful effect of voltaic electricity in eroding or oxidising metallic substances, is evinced by its action in the galvanic circle; and to prove that its power and influence extends over the whole range of terrestrial substances, we need only refer to the experiments made with the battery of the Royal Institution, wherein it was seen, that when the fluid was highly concentrated, platina melted in it as wax in the flame of a candle; some of the more refractory substances, as quartz, the sapphire, magnesia, and lime, all entered into fusion; fragments of diamond, points of charcoal, and plumbago, quickly disappeared, and seemed converted into vapour. Now, as the sources of motion are exhausted in the same proportion as the effects they produce, if this rule be applicable to voltaic electricity, we are justified in the inference, that the earth's galvanic influence will exhaust itself. We make no attempt to limit the extent of its duration, or to fix the number of galvanic circles that may be formed successively, as each of the preceeding is exhausted; all that we mean to infer is, that in every successive action the elements become changed in their chemical and electrical properties and affinities, and rendered incapable of being acted upon again under the former circumstances; and that when the whole round of chemico-electrical processes shall have been operated, chemical action will cease, the galvanic circle will be incomplete, and the earth, like the moon, will cease to revolve on her axis. It is further assumed, that in proportion as the voltaic electricity circulating within the crust of the earth proceeds in oxidising and vitrifying the various conducting substances on which it operates, the earth's affinity for electricity is weakened; and as the internal fluid is continually being evolved by the internal action, whilst the capacity of the earth for attracting and retaining the electric fluid is becoming feeble in a corresponding degree, and consequently, the earth is approximating nearer and nearer to a negative state, and is, therefore, attracted nearer and nearer to the sun, until it ultimately falls back into the sun, a worn-out and exhausted planet. All this

corresponds with the natural phenomena that comes under our immediate observation; wherever we see organized life, we see that it has a birth, that it comes to maturity, and gradually decays; wherever we see motion, we see that it exhausts itself in a ratio corresponding with its intensity; and therefore, reasoning from analogy, we are justified in the inference, that the same rule and order may hold also in the heavenly bodies.

8. That the moon is gradually approximating towards the earth is an obvious corollary of the foregoing theory; and here we shall be enabled to draw our inferences from two sources, astronomy and geology; and, consequently, in the latter, from matters that come more immediately under our observation, for we hold, that at one time the earth occupied the places now occupied by Georgium Sidus, Saturn, and Jupiter, each respectively in the order of their succession, that at that period of her existence she was of much larger diameter than at this present time, and was probably attended by three, four, or more moons, the wrecks of all of which, save one, are now scattered upon the surface of the earth—and in these wrecks we expect to find further evidence of the truth of our theory.

(*To be continued.*)

ON THE PRESERVATION OF TIMBER FROM THE DRY ROT BY THE CORROSIVE SUBLIMATE OF MERCURY.

The Minister for the Marine and Colonies of France applied a short time ago to the Royal Academy for their opinion respecting the efficacy of a solution of corrosive sublimate as a preservative of the timber, sails, and cordage of ships. A commission of five members was appointed to make the requisite inquiries, and to draw up a report of their proceedings. The report commences with a rapid survey of the various means which had been proposed and tried previous to the introduction of the corrosive sublimate. Among the numerous preservatives at different times recommended, we may enumerate various resins, animal, vegetable, and mineral oils, the muriate of soda, the nitrate of potass, quick-lime, baryta, the species of pyrites (?), which the English call "mundic," and which is partly composed of arsenic. This latter substance mixed with water was used to wash the timbers of the Queen Charlotte with; but the shipwrights employed in the work suffered severely from swellings of the glands, and two of them died in consequence. A practice which has been for a great length of time in use in many arsenals is to keep all their store or reserve timber floating in or sunk under sea-water: but this method too has its disadvantages; for the wood thereby loses its proper density and strength, and it cannot, but with difficulty, be afterwards ever thoroughly dried. The saline matter, with which it has become impregnated, is apt to dissolve whenever the atmosphere is damp; and thus a vessel built of such timber is inevitably rendered uncomfortable and even unhealthy. The oxidation too of the iron and copper work is greatly accelerated by the presence of the muriate of soda. Lastly, it may be stated that the wood thus seasoned is by no means exempt from the very evil which the remedy has been used to counteract. In order that timber may remain sound for a length of time, it is necessary that it be thoroughly dried. The drying of timber is usually effected by exposing it for a length of time (under shelter if possible) to the air. But this being a tedious process, (three years may be stated as the average time required,) recourse has been had to artificial warmth. A too high degree of heat weakens the ligneous fibre, and by dissipating all its humidity—a certain degree of which is necessary to its suppleness and strength—renders it friable and disposed to split. It has been recommended to dry and to preserve timber in beds of dried sand; but this plan is evidently inapplicable for large quantities of wood.

The process of that disorganization of wood, so well known by the name of the dry-rot, has been repeatedly examined. The following appear to be the progressive steps of this destructive change. The wood being more or less humid, whether from retaining part of its natural humidity, or, in consequence of the long immersion to which it was during its seasoning subjected, commences to undergo a sort of heating or fermentation, the result of some internal molecular movement, analogous to that which takes place during the decomposition of animal matters. By this fermentation and dissolution of the juices of the wood, the reticular ligneous tissue gradually softens and cracks; and in the cracks or fissures thus formed various cryptogamic plants begin to vegetate. The vegetations, which are in truth not the primary causes of the mischief, but are rather the result of the preceding changes, multiply and increase in every direction, breaking up and disorganizing the ligneous tissue. This development of regular organized vegetable productions succeeding to a previous decay of the wood, may be aptly compared to the generation of worms in putrefying aminal matter.

Such appears to be the process of what has been called the dry-rot, or caries of wood; a morbid action which commences with a sort of intestine fermentation or decomposition of the ligneous fibre, and terminates by the production of various cryptogamic plants in its tissue. It had been long well known that the corrosive sublimate of mercury has a powerful effect in arresting the putrid fermentation and decomposition of animal matters. It had been used in preserving antimonial preparations, objects of natural history, in embalming, &c. The most putrescent structures, such as the nervous pulp, acquires a firmness from the sublimate, which enables it to resist decay. Botanists, too, had frequently employed it in the preservation of their herbaria. So far back as the year 1815,

Dr. Bailli of Toulouse had suggested the expedient of immersing wood in a solution of corrosive sublimate to preserve it from speedy decay. But we do not propose to dispute the claims of the Englishman, Mr. Kyan, who has recently brought the proposal more formally and more minutely under the attention of his own as well as of our Government.

The solution which he recomends is made by dissolving about a pound of the salt in about eight or ten gallons of water. The requisite period for maceration must vary, according to thickness and hardness of the timber, from a week to three or more. The sails and cordage do not require more than a couple of days.

Several experiments were made at Woolwich to ascertain the preservative powers of Mr. Kyan's solution. Pieces of wood which had been subjected to it, and others which had not, were left for a twelve-month in a ditch. A quantity of decayed and rotting timber had been thrown in along with the sound, and the whole had been kept rather warm, for the purpose of encouraging the fermentation.

When removed at the end of the twelvemonth, the *prepared* wood was found to be perfectly sound throughout, while the other pieces were all more or less rotten.

The French chemist, M. Henry, has made numerous experiments to ascertain the mode, in which the sublimate probably operates, as a preservative of timber. He has shewn that the salt so employed is in a great measure speedily converted into the state of protochloride, and that, in passing to this state, it forms a combination with the albuminous juices of the wood. There is thus formed a new organic compound, fixed and insoluble, and the vegetable juices are no longer liable to be affected by moisture, or susceptible of that fermentation, which we regard to be the primary and essential stage of the dry rot.

In reference to the question whether the wood, &c. prepared by Mr. Kyan's method is likely to prove hurtful to the shipwright, or to the crew of a ship which has been built of it, we may allude to some observations of Mr. Faraday. This distinguished chemist inform us that many years ago, his great predecessor, Sir H. Davy, was consulted by the late Lord Spencer, as to the propriety of using the corrosive sublimate to preserve his valuable library from the attack of insects. Both Sir H. and Mr. Faraday were rather unfriendly to its use, on the ground that it might become volatilised, and thus impregnate the atmosphere of the rooms with poisonous particles. But Mr. F. has subsequently changed his opinion, and he is now convinced that his fears were unnecessary. As a matter of course there is infinitely less risk of any such injurious consequences from wood which has been merely saturated in a solution of the salt, than from using the powder of the salt itself to sprinkle on books, or other objects. But we have already stated that the prepared wood retains very little of the undecomposed poisonous salt, the greater part of it being speedily converted into the innocent protes-chloride. The efflorescence which may be often observed on wood which has been immersed in the preserving liquor, consists chiefly of this latter compound.

Already an experiment has been made in England on a large scale, to ascertain whether there is any truth in the objections which have been urged against Mr. Kyan's proposal. A South Sea Whaling vessel was built some time ago at Cowes, altogether of timber which had been seasoned as Mr. K. recommends. No accident occurred among the workmen in the building-yard, and the crew had lived for two months on board of the ship before she sailed, without experiencing any inconveniencies. It will be interesting to know the result of the experiment when she returns after a two, or three years' voyage.

We hear that Mr. Kyan has abandoned his project of preparing the cordage with the same solution ; and he has suggested in lieu of it, a solution of caoutchouc, which, while it protects them against moisture, may serve to make them more elastic.

On the whole the report presented by M. Karaudern to the Acadamy must be deemed highly favorable to the proposal of Mr. Kyan.

THE SPIRIT OF THE INDIAN PRESS,

OR MONTHLY REGISTER OF USEFUL INVENTIONS,

AND IMPROVEMENTS, DISCOVERIES, AND NEW FACTS IN EVERY DEPARTMENT OF SCIENCE.

RELICS FROM CAUBUL.

The *Courier* of Bombay states that a very valuable box of relics has reached the presidency from Cabool. It appears that some time since this Government placed at the disposal of Mr. Masson several thousand rupees for the purpose of excavating some of those singular buildings called "Topes" in that country, the expenditure of which has terminated most successfully. Intrinsically even, we have been informed, the relics are of considerable value, consisting of several thousand coins in gold, silver, and copper, as well as some golden boxes; but in a historical point of view, they will

prove of the first importance in elucidating the history of that part of Asia. Most of the coins are Greek—chiefly of the Bactrian monarchs There are also Roman coins, as well as of the native dynasties that have reigned in Cabool.—The tope of Manikayala (a drawing of which may be seen in Mr. Elphinstone's work on Cabool) opened by Mr. Veutura, gave the first impetus to the examination of these curious buildings.

We hope, at a future time, to be able to give a more detailed account of these curiosities which are, it is said, far superior in interest to any of the same kind that have been yet brought to light.

CENTRAL ASIA BY WAY OF INDIA AND AFFGHANISTAN.

We learn from the same source the amount of the trade in British goods through Affghanistan which has recently been ascertained to be very great. M. Masson, who is considered unquestionable authority, estimates that portion of it which passes through Caubul alone, as worth no less than £793,000!

To extend this trade we understand it is proposed to establish fairs on the Indus like those of Leipsic and Novogorod, to both of which traders from nearly all Europe and Asia resort; and Capt. Burnes has been required among other things, to ascertain the practicability of the scheme. Runjeet Sing, it is also said, has been spoken to regarding it, and has entered into it with eagerness. We still trust, therefore, at no distant period, to see a considerable trade on the Indus, and advantage taken of the facilities that magnificent stream is calculated to afford.—Already, indeed, commerce is extending in that quarter. The great obstacle to its advancement has always been the want of some staple commodity as a return for investments made in Europe goods, &c. This however has at length been discovered; and wool from the Indus is already an important article of trade here, though it has only been imported for two or three seasons. To what extent it may be procured we cannot say; but judging from the infancy of the trade, the rapidity with which it has extended since it was discovered that wool was a saleable commodity in Bombay, and the extent of the flocks of sheep in Caubul, Candahar and the adjoining countries, it is not unreasonable to suppose it will soon rank high in the list of our exports.

The rise and progress of this branch of trade deserves to be mentioned, showing as it does how much the resources of the country may be developed by a little enterprise and encouragement.

The exports, since the trade commenced—three years since—have been as follows:—

1833	106 bales.
1834	439—„—
1835	2,290—„—

This year 3,692 bales have already been exported, and the shipments are increasing daily.

The accounts too from England are becomign more and more favourable as the wool becomes better known to the manufacturers in that country.

THE SALT WATER LAKE OF CALCUTTA.

Draining the Salt Water Lake of Calcutta was projected by Lord William Bentinck, we learn from a minute in the financial and revenue department. It is believed that the lowest bed of the Salt Water Lake is at 2, that the depth is from 1½ to 2 feet, and some where exceeds 2½ feet, that the neap tides in the Hooghley in March are 5 feet 4 inches and the lowest springs in March 7 feet 5 inches below the lowest bed of the lake, in the one case giving 3 feet 4 inches, and in the other 5 feet 5 inches fall. It is evident from this, the complete drainage of the lake either into the Hoogly itself, or into the Canal is perfectly practicable.

The warping up of the lake is a still more easy and certain operation, in as much as in the months of March, April and May, the springs in the Hoogley are ten feet higher than the lowest bed of the lake, and the highest rise of the river in August and September, is between 15 and 16 feet; vide daily register of tides in the Hoogley at Calcutta from 1805 to 1828, by James Kyd, Esq.

Nor can a doubt be for one moment entertained of the great superiority of a deep canal of fixed and even dimensions, with high banks, serving as roads, and tow paths, over a navigable shallow channel through an open lake only to be kept open by the use of a dredging machine, and not having the benefit of a lateral embankment except it be made at a considerable expense.

The lake, according to Captain Prinsep's estimate, contains 18½ square miles, equal to 12,000 acres or 36,000 Bengal Bigahs. The lowest rent of these lands near Calcutta is 2 rupees per Bigah the lowest amount of rent, as well as produce of the lowest value is taken; such land might reasonably be expected to grow indigo, cotton, or sugar cane. The yearly produce at 2 rupees per Bigah would be 72,000 or £7,200 or very nearly equal to the whole cost of the cut. Mr. Dampier, the commissioner of the Sunderbuns, in whose jurisdiction the Salt Water Lake is situated, estimates the quantity of bigahs at 60,000, and the rent at more than 2 rupees, but it will be safer to take Captain Prinsep's estimate.

Lord William thought that the general salubrity of this great city, and the vast improvement to navigation by a good canal instead of a shallow channel, through the open lake, were objects of such superior importance that he put all gain and profit out of the question. But it would be satisfactory at any rate, even without any prospect of collateral advantage, that so much good could be attained at so little cost.

It is necessary to remark that the Salt Water Lake has been disposed of in perpetuity, paying a rent of about 4,000 rupees to Government. The profit the zemindars, as he learn from the Commissioner, from the fisheries, from reeds, and from lands, from which the waters have] receded, amounts to above 16,000 rupees; he learnt from the some resource

that the proprietors would not be unwilling to sell their property. There is a doubt whether the land, as well as the water, and the right of fishery, belongs to the zemindar, or to the state, the right is about to be tried.

Lord William proposed that this minute with its accompanying documents, might be submitted to the Hon'ble Court, with his request that the plan may be laid before Messrs. Telford, and John and George Rennie, for their opinion upon its practicability, and for such suggestions, and directions, as they are so well enabled to give for its execution. He proposed these gentlemen, because they had been Engineers in the works to which he himself was a party, and they would therefore better understand his meaning.

He further proposed if the Court should feel doubtful of the practicability, or being satisfied upon that head, should be unwilling to undertake it, that they would permit individuals including their servants to embark their money in the work.

It would be fair, he thought, that one half of the expense of the new proposed cut, should be borne by the Company, in return for the improved navigation and the greater increase of Tolls that would accrue therefrom. The proprietors of the Salt Water Lake would of course continue to pay the same jumma to Government as heretofore.

SUGAR CULTIVATION.

On this subject the *Conservative* of Madras observes,

The present time is certainly favourable for the extension of Sugar cultivation in India, as it appears clear beyond controversy that a falling off will take place in that article in the West Indies at the expiration of the apprenticeship act. The West India Islands even under the present system are inadequately supplied with labour, and amongst proprietors there is much apprehension that the apprentices will not work at all when no longer compelled to do so: one thing is certain that if the West India Negro is no great political economist, he is at all events a practical philosopher, and his present idea of absolute freedom and consequent happiness is that of setting under the shade all day long. He is as yet insensible to the moral stimulus of bettering his condition, and it is to be feared when left to himself he will only labour to the extent of procuring subsistence, which may be about a month in each year.—Notwithstanding this apprehension we are far from being of the opinion of some enthusiasts in Bengal who prognosticate the downfall of the West Indies from the passing of the late Act: sorry indeed should we be to see the ruin of these "*gems set in the silver sea*; their standing or falling is a question of vital importance to England: and sorry should we be to see the fair Island of the Mauritius sinking again in a commercial point of view into the insignificance from which it has within these last few years emerged.

As regards the latter Island there is little to be apprehended, as its superiority of soil over India, and the success of the experiment made two years ago of importing labourers from this country give advantages to its industrious and deserving colonists. —We have reason to suppose that before long Natives from this country will be imported in considerable numbers to our West India Islands upon the same terms as those who have been sent to the Mauritius. Should their importation be attended with equal success, we do not think the West India Proprietors, have much to apprehend from any extension of the culture of Sugar Cane which may take place in this country—the superiority of soil in the West Indies will compensate for the higher price which must be paid for the labour of those who are employed in the cultivation of the Cane and the manufacture of its products.

EXPENSES OF THE OVERLAND ROUTE.

The following on the above subject is important information to those who may be inclined to proceed home in this way, a statement of the expenses attending it is of interest.

The economy of this mode of travelling has long been no secret. The whole amount paid by Major Davies for himself and Mrs. Davies between London and Bombay, enjoying by the way a trip up the Rhine and through Italy, was only £126 each; and yet it would seem that they might have performed the journey for considerably less, had they arrived in the Red Sea earlier in the season and been freed from the extra charges they were obliged to pay for a passage to this port. It will be observed, too, that they diverged a little from the direct route, by proceeding to Brussels, which must have increased their expenses.—For two or three bachelors, therefore, travelling in company, and who are willing to put up with little inconveniences, £100 each, there is reason to believe, will be sufficient for the journey.

TO THE EDITOR OF THE COURIER.

Sir,—It having been suggested to me that any information regarding the expenses incurred and time occupied, in a journey from England to Bombay by way of Egypt, would be interesting to others, contemplating the same, I beg leave to send you a rough sketch of what it cost me together with Mrs. Davies.—The season ought to be considered; for Steamers were not going in the Red Sea.

We left England on the 19th May, and arrived in Bombay, 20th September 1836. The routes from Malta are various, and all interesting, but as Steamers are now constantly going from Malta to Naples, that would be thought the best by most people; but of course every one will decide for himself, as he gets on, what route to pursue. My object is merely to state, in a rough sketch, what it cost me, and I may add, that with the exception of the heat in the Red Sea at the season we came, we accomplished the journey without the least difficulty, and were most highly pleased with the many interesting sights and scenery we thus had an opportunity of seeing.

C. Davis, *Major, Bombay Army.*

FARES AND PASSAGE MONEY.

From London to	Miles.	Actual travelling,	Amount paid for conveyance. £ s. d.	
Antwerp	220	2 days	4 4 0	Steam packet 30 hrs.
Brussels	30		0 5 0	Steam carriage 1 hour and half.
Liege	64	1 "	1 2 0	Diligence.
Aix la Chapelle Cologne	75	2 "	2 14 6	Voiture.
Coblentz	53	1 ,,	1 2 0	Steam vessel on the Rhine.
Mayence	60	1 ,,	1 1 6	do. do.
Manheim	27	1 ,,	0 13 0	do. do.
Heidelberg	10		0 8 0	Voiture.
Stutgard	70	1 ,,	1 13 0	Diligence.
Innspruck	202	4 ,,	6 2 6	Voiture.
Verona	191	4 ,,	5 3 6	do.
Modena, changed Voiture & crossed the Appenines by the Betuna pass to Florence.	180	5 ,,	8 8 8	do.
Leghorn	60	1 ,,	2 2 0	do.
Malta	500	11 ,,	17 0 0	Brigantine.
Alexandria	700	12 ,,	18 0 0	Schooner.
Atfe Canal, joins the Nile	40	1 ,,	1 0 0	Arab boat
Boulac, port of Cairo	100	2 ,,	4 0 0	Insurance company's boat.
Suez, crossed the desert	80	2 ,,	6 0 0	Camels and Donkies.
Jedda	540	17 ,,	11 6 0	Arab boat.
Mocha	480	11 ,,	10 3 8	Arab ship.
Bombay	1800	20 ,,	60 0 0	Surat ship.
	5491	99	£162 14 0	

EXPENSES AT INNS, &c.

Expenses at Inns in Europe	25 0 0
Do. at Malta, supplies for Egypt, &c.	10 0 0
Do. do. Beverly's Hotel	7 9 7
Do. Alexandria Mrs. Hume's hotel and some supplies, and at Cairo, Mrs. Hall's hotel and other expenses in Egypt	30 0 0
Do. Suez, Tor, Yamboo	2 0 0
Do. Jedda	5 0 0
Do. Servants from Alexandria to Jedda	4 0 0
Do. Hodeida and Mocha	3 15 0
Servant from Jedda to Bombay	2 0 0
	£89 4 7

Total for two persons—£251 18 7

COTTON.

Dr. Lush has communicated a valuable paper, on the cultivation and preparation of Cotton in the districts under the Bombay presidency.

The determination of the species and varieties of *Cotton*, of the genus *Gossypium*, to speak in correct botanical language is no easy problem. Dr. T. Hamilton Buchanan, who believed he had seen all the kinds then grown in India including four or five generally allowed by authors to be specifically distinct, *all growing in the same field and* produced from *the* same *seed* admitted only three species. One species with white fibre and *white* or *green* seed:—examples—common Indian cotton, American upland, &c.

A second species with white fibre and black seed—Bourbon, &c.

A third species with *yellow fibre.*—viz. Nankin cotton.

This simplification however startling to those who have seen the seemingly well drilled ranks of species in standard botanical works, is very near the truth. Following nearly the same principle, Dr. Lush would reject the Nankin as not specifically distinct from the common Indian and American, and acknowledge the Pernambuco or kidney cotton as a decided species. M. De Candolle?.* observes that—After giving the generic character of Gossypium, he adds "N. B. species omnes incertæ ex characteribus mancis stabilitæ. Genus monographiæ accuratæ et ex vivo elaboratæ maxime egere!" True;—but if the drawings and descriptions are to be made from cultivated kinds, the existing confusion will be increased. It is only the description of those found in an undoubtedly wild state, that can be of service to the botanist, and the benefit to the cultivator could but be small. It is remarkable that M. De Candolle marks the *Gossypium acuminatum* of Roxburgh which is no other than the kidney or Pernambuco cotton, as a doubtful species. Now it is not only clearly described by Roxburgh but is the most distinct species and the most unvarying in charac-

* De Condolle. Prodromus syst. naturalis regni veget pars 1 p p. 456.

ter, that is to be found at this moment growing in India.

The Cotton imported into Bombay has been calculated to have increased within a *very* few years, from the annual value of 80 or 90 lakhs of rupees, to the amount of near three crores. No material improvement can have taken place in the staple, and the Cotton of the once despised districs of Surat, &c. now fetches a price at least equal to that of upland Georgia in 1829. The fact is, that the rise of price has suggested new modes of separating the impurities at home, and a dirty, short-fibred Cotton, now turns out not so bad an article. The cultivation even in very inferior land has greatly increased and still increases rapidly. In this career are we likely to receive a check? In 1829, Surats, &c. were quoted at 3d ⅝ per lb. In 1835, he find that (before the late rise) the worst sample he could procure of Cotton very inferior to Surat (some vile Compta) said by Company's brokers to be "badly cleaned, tender staple and stained" was valued at 6¾d per lb. Now Dr. Lush is convinced that the grower and the merchant may yet get ample profit when the best Indian cottons are at 5d. per lb. As long as there exists so little difference between very dirty and very clean Cotton, as there is at present, —and he knows no reason why this comparative ratio should change,—we need not fear, he says, what some please to term competition with America. Our cotton may well afford to stand a little abuse while so high a price is paid for it. We have the satisfaction of knowing that we can stand up against a great reduction in price below the present rates.—

REPORT ON THE STATE AND NAVIGATION OF THE INDUS BELOW HYDERABAD.

About 50 miles from the sea the River Indus, it is well known, divides into two grand arms the Buggaur and the Setta. During the dry season no communication now exists between the Buggaur and main stream, a sand bank having accumulated at the confluence which is 5 or 6 feet above the level of the water; in all the branches diverging from it the water is salt for the greater part of the year, and they are then merely inlets of the sea. The Setta or Eastern arm pursues the same course to the ocean as the great river from which it is supplied, and is in fact a continuation of it; in every part it preserves a similar magnitude, and for a long a period it has been, as it is now, the principal channel of the Indus; in its passage to the sea it receives many local appellations, but is best known near the coast as the Munnejah or wanyanee. Of the four branches it sends off, the Mull and Mountee are impassable at the point where they leave the parent stream, and nothing is now seen of these once noble rivers but two shallow rivulets, one of which you may step across and the other but a few yards wide. The Hujamree and Kedywaree are the only two now favored to any extent by the fresh water, or which possess navigable channels into the main river; the latter however can scarcely be called a branch, for it is merely a shallow creek with a broad entrance that quits the Munnejah near its mouth. Above the Delta two more branches are thrown off by the Indus, the Pinyaree and Fulailee which are rivers only during the inundation: after it has subsided they dry up for miles, and are besides closed by bunds thrown across them above the Seaport towns.

The Indus formerly reached the sea through eleven large mouths, but three of them now suffice in the dry season, to discharge its water; of these the Phittee, Pyntianee, Junah and Richael belong to the Buggaur and the Hujamree, Kedywaree, Kookewaree, Kaheel, and Mull to the Setta: the Seer and Koree and entrances to the Pinyaree and Fulailee branches and complete the number. Besides these, there are many small mouths, but as it would only tend to confuse, I shall not name them. At present the Kookewaree, which gives egress to the waters of the Munnejah River, is the grand embouchure of the Indus; in the late Maps it is called the Gota, but erroneously so, for that mouth was deserted by the stream some years ago, and its site is now occupied by an extensive swamp.

Between the Eastern and Western mouths the Coast of the Delta runs nearly in a strait direction to the N. W. about 125 miles: in the charts now in use it is laid down above half a degree too far to the Eastward, and the same error will be found in every part that exists at the mouths of the Hujamree and Koree, where the longitude has been ascertained by numerous observations: the former is in 67 d. 25 m. 21s. East, and the latter in 68d. 80 m. East. The shore is low and flat throughout, and at high water partially overflowed to a considerable distance inland; with the exception of a few spots covered with jungle it is entirely destitute of trees or shurbs, and nothing is seen for many miles but a dreary swamp: wherever this occurs the land is scarcely discernible two miles from the shore, but at those parts where there are bushes, it is visible from the deck of a small vessel double that distance. On a coast so devoid of objects and partly submerged at times, it is often difficult to distinguish the mouths of the different rivers, and but few directions can be given to assist the navigator in finding them. The Seer is known by some sand-heaps topped with bushes on its North point, which are sufficiently elevated to be visible some distance; the Cutch Pilots call this point Douppee and always stands into sight it, before they steer for the Munnejah bank. There is a similar spot at the Richael mouth, which also serves as a guide in approaching the Hujamree River two miles below it. The bank every where projecting from the coast, extends from the Bay of Corachee to the N. W. extremity of Cutch. In breadth it varies considerably: off the mouth of the Setta, where broad flats have been cast up by the greater strength of the tide, it runs out in some places 5 or 6 miles, and at low water is dry for a distance of 15 miles along the shore; at the Koree mouth it is of a similar breadth but only dries here and there in small patches: in other parts the outeredge is only 2 or 3 miles from the land, and sometimes less, and at low tide it has a depth of water on it, which from 2½ fathoms decreases gradually to 4 or 5 feet. On the bank the bottom is smooth and hard, but outside is composed of soft mud. The tides are extremely irregular; between the Seer and Mull mouths, 80 miles apart, the current sets constantly to the E. S E., and the flood or ebb can only be distinguished by the rise or fall of water, which is not more than 4 feet: near the Munnejah bank, the ebb runs with some strenghth directly off shore, and the rise and fall increases to 12 feet: in other parts where the channels are numerous, the tides change their direction every hour, and they are scarcely felt at a greater distance than 2 or 3 miles from the shore.

During the fine season the Sinde Coast may be navigated without difficulty; the soundings are every where a sufficient guide, and in general decrease so gradually and with such regularity, that no danger is to be apprehended in approaching it. The only shoal of any consequence is the Great Munnejah Bank, which projects beyond the line of the direct rout to the Northern rivers. In passing it during

the night large vessels ought not to come under 7 fathoms, for it is rather steep in some parts, and from that depth the soundings decrease very rapidly. Land and sea breezes generally prevail with cold clear weather, but the wind sometimes blows very fresh from the N. E. and the atmosphere is obscured by clouds of dust. The fine season is over long before it terminates on the Malabar Coast, and the navigation becomes very dangerous. Early in February the Westerly winds set in with considerable violence, and for the first fortnight the weather is always very tempestuous; strong gales are also sometimes encountered in this month, and there is a heavy tumultuous sea continually running, which breaks across the mouths of most of the Rivers. In 1833 the Shannon Schooner was caught in one that lasted 12 hours, and cause the destruction of 10 or 12 large boats which were wrecked on different parts of the coast. Short intervals of fine weather occur afterwards until the middle of March, but after that date the mouths of the Indus may be considered closed for the season.

Besides the Munnejah or main river there is only one branch, the Hujamree, now available for the purpose of opening a communication with the upper part of the Indus: a trigonometrical survey of it has been completed, and the former has been carefully examined from Hyderabad to its mouth.

The mouth of the Hujamree opens like a funnel, and with the exception of that part where the river takes its course along the right bank, is occupied by a broad flat, partially covered with water: this forms a continuation of the bank every where extending from the coast which is here rather more than a mile in breadth. The best channel for crossing it runs in a N N. E. direction towards the North point of the river, and is 600 yards wide: at the entrance there are heavy breakers on either side, and at high water no greater depth is found on the bar which is about half a mile inside, than 13 feet. Besides this channel, there is another that crosses the bank in an Easterly line three or four hundred yards above it, but it is extremely shallow, and can only be used by the smallest boats in moderate weather. About this mouth, which is situated in 248' 20); North Latitude, the land is entirely destitute of objects that could be pointed out as marks to guide the navigator, and without the assistance of a Pilot a stranger would have some difficulty in finding it: the Cutch boatmen never attempt to steer for it until they have seen the North point of the Richel, which being covered with mangrove jungle is visible some distance, and enables them to ascertain their position correctly, There is however no danger in approaching it during the fine season, for the soundings decrease with the greatest regularity up to the edge of the shoals, and the breakers on them are visible when in 4 or 5 fathoms water.

(To be continued.)

THE CINNAMON TRADE.

The following from the Ceylon Observer is the official Statement of the Government Stock of Cinnamon on hand, and that of the Export for the year ending 31st August 1836, it will be seen that the quantity of the spice shipped during that time was about 5,318 bales, being within about 182 bales of what is said by Government to have been exported annually during the monopoly. If the high prices that have lately been given for all sorts of Cinnamon, and the increased sale of the first quality be taken into consideration, we conceive that the state of the Trade will soon, incontestibly, prove the erroneous views once maintained by those who would have preserved the *peculiar* monopoly of this Article from the idea that the abolition of it would have ruined the revenues of the Colony and even the Trade itself. From the manner in which the Government Sales are conducted they still, however, approach too nearly to a monopoly. A certain number of bales are monthly put up to Auction at an upset price, and however great the demand may be no more will then be disposed of. Government are still almost the sole producers and proprietors of the article, of which they might bring a much greater quantity into the market from their present stock, and continue to do so were common attention paid to their Gardens. Instead of doing this and disposing of a much larger quantity at a somewhat reduced rate, with their usual short-sighted policy they content themselves with selling a small quantity at a high price upon which they afterwards levy an exorbitant duty. How frequently has it been shewn that by this conduct they offer a bonus to foreigners to cultivate the spice; and in support of this conclusion we have to state another instance in the Dutch, who have now also become competitors in the cultivation of Cinnamon, of which they have grown excellent qualities at Java.

NATURAL PRODUCTIONS OF INDIA.

To the Editor of the Agra Ukhbar.

SIR,—I respectfully beg to offer for publication the following memorandum on the refining of Carbonate of Soda from the impure mineral Alkali found in abundance throughout the Western Provinces, and more especially in the vicinity of the Jumna, and which I am strongly inclined to believe must become a substance of great mercantile importance and value, as soon as its properties, and extensive consumption in medicine, the arts, and manufactures, become more fully known and appreciated.

If this specimen of the application of practical Chemistry merit approval, it may be followed by some others executed with the view to facilitate the preparation of the indigenous productions of the Country.

JOHN DOUGLAS, *Apothecary,*

Landour, 30*th Sept.* 1836.

My attention having been drawn last cold season to the abundant and inexhaustible supply of impure Carbonate of Soda (Rae ka Muttee) found in the state of efflorescence on the surface of the ground throughout the Western Provinces, and in particular to the practicability, of refining it in the most advantageous and economical manner, so as to render it most suitable as an article of commercial speculation and export, I beg to bespeak an indulgent consideration for the following memorandum on the subject, the result of my observations and experiments.

Regarding the natural phenomena which attend the formation of this mineral it may be briefly premised.—

That, on an examination of those localities where it is found efflorescent in the greatest purity and whiteness, a superficial stratum of Carbonate of Lime is almost invariably to be found in it under the shape of kunkur, and the water in the kucha wells in the immediate neighbourhood is saline and bitter, in short, it is generally so strongly impregnated with muriate of Soda as to be made available by the native salt makers for the manufacture of the coarsest qualities of country salt.

On a consideration of these circumstances it may be inferred that a mutual process of decomposition is continually, and imperceptibly going forward between the Muriate of Soda and Carbonate of Lime promoted, and modified more or less by the influence of the solar heat, the Carbonate of

soda is separated, and perhaps absorbing Carbonic acid from the atmosphere, it spontaneously assumes efflorescent state in which it appears at all times of the year when the weather is clear and dry, but in the greatest purity and perfection during the months of March, April, May, and June, in short until the commencement of the rains.

The efflorescent alkali when gathered is mixed with, and deteriorated by earthy and calcareous impurities, besides it is liable to be discoloured by the vegetable matter with which it is found in contact, such as the roots of grass and the decayed branches, and twigs of tringard bushes—the principal object, therefore, in refining it is to destroy and separate it from such imperfections.

For this purpose different plans may be pursued; I prefer that which follows, being grounded on actual experiment, and the least expensive.

A few fields may be selected on which the efflorescence appears most plentiful and clean. (The washermen always know where such fields are to be found,) Let it be gathered in small heaps separating as much as possible, the grass and its roots, the little stalks of rotten plants, the pieces of kunkur must also be picked out; this will be best down in the baskets, in which it is to be taken up and carried to the vicinity of the kiln where it is to be collected and formed into a mound of a pyramidal shape. The ground on which it is built being raised a little so as to prevent it being injured by the dampness.

The mound during its formation may be thoroughly beat down by wooden mallets, that it may be as solid as possible—in the course of a few days a rich and beautifully white efflorescence will appear on its sides, particularly on the side most exposed to the rays of the sun. This efflorescence as it forms, may be detached, or rather shaved off by a common grasscutters kurpah; it may then be transferred to a kiln to be calcined and freed from its vegetable impurities.

The common country kiln is very suitable for the purpose intended, only it may be narrower and deeper in its construction, and of a capacity proportionate to the quantity of Alkali to be prepared. The calcination must be continued until the vegetable matter be completely consumed, and the carbonic acid dissipated, in short it will become caustic, and similar to lime after having undergone a similar process. Dry cow dung is an excellent and cheap fuel, and the calcination after it has commenced, may be continued by throwing in fresh efflorescent Soda by the top, whilst the calcined Soda may be drawn out from the air-hole at the bottom of the kiln.

The calcined Soda may now be dissolved in clean soft water, and lixiviated so as to allow the insoluble matter to fall to the bottom, and obtain a clear caustic ley or solution. This solution may be further purified by passing it through a filter of clean river sand and charcoal placed on a wicker basket. The basket by means of a couple of crossed sticks may be fixed over the boiler, so that the solution may drop into it, and the evaporation may then commence which is the next step in the process. The boiling must be continued, adding fresh ley through the filter until it begins to appear quiescent and smooth on the surface like oil; at this stage, a little of the solution may be taken out and cooled on a bit of glass to show its strength by the quantity of salt that will remain upon it—if that be considerable, the fire may be withdrawn; the solution when cool will concrete into a mass of Soda of the most valuable and purest quality - and after it has been exposed to the atmosphere it will soften and become pasty, and then by the absorption of Carbonic acid it passes into a clean efflorescent Carbonate, in the most advantageous state to be used in the numerous manufactures, for which it is in such general demand.

If it be desirable to obtain the chrystalized Carbonate of Soda it may be dissolved in hot water and exposed to the night air, and if it be cold enough chrystals will be formed, which if slightly discoloured will become quite pure and white if spread out for a day or two in the heat of the sun.

I apprehend the refining of crude Soda might be carried on under great advantage in the vicinity of Agra, because the crude mineral may be procured by the mere trouble of gathering it—the lands on which it is found being barren and sterile and useless for agricultural purposes; the expence of fuel is easily ascertained, as well as the attendance the process of manufacture would require. A boiler such as is used for making coarse sugar, (Jagree,) would evaporate about a maund of alkali every second day, and the river is conveniently available to transport it to the Calcutta market.

Analysis of a Sample of Chrystalized Carbonate of Soda prepared in conformity to the method described in this memorandum is subjoined, for brevity's sake the results of the application of the tests are stated.

First experiment—shewed the presence of an Acid either Carbonic or Sulphuric.

Second experiment—shewed Carbonic Acid, no Sulphuric.

Third experiment.—The same experiment with a different test; again the same result.

Fourth experiment—indicated a small trace of Muriatic Acid.

Fifth experiment—shewed a fixed Alkali either free or in Combination with Carbonic Acid.

Sixth experiment—shewed the Alkali to be Soda in combination with Carbonic Acid.

STATE OF THE COTTON CROP.

We have published in a previous column an abstract from the official returns, lately received from the collectorates of Surat, Broach, Poona and Ahmudnuggur, of the extent of the cotton cultivation within those districts.

In consequence of the unusually heavy falls of rain in Guzerat this season, an idea prevails that the ensuing crop of cotton will be greatly deficient. This, however, seems likely to prove erroneous; for, though the destruction of the early sowings in the principal cotton districts has been quite enormous, it will be counterbalanced in a great measure within those very districts by the unusual exertions made to resow the lands that have suffered; while in the Deccan no losses have occurred, and the cultivation has more than doubled within a twelve-month.

What the state of the crop is in Candeish, Kattywar, and the Southern Mahratta country we cannot say, as no returns have yet been received from them; but it is certain that, in all these districts, the weather has been most favorable, and as the causes which have led to the improvement in the Deccan have been such as operate throughout the country, it may be inferred that the effect has been equally general.

The total decrease of cultivation in Broach and Surat is stated at 53,608 beegas. Allowing, therefore, 5 maunds to the beega, those two provinces will produce 9,572 candies less than last season. Against this, at the same rate of computation, we have an increase of 2,915 candies from the Deccan. It will not, therefore, supposing the yield to be as good this year as last. require a very great increase in the produce of the other districts, to render the extent of the present crop fully equal to that of the last.—*Bombay Courier*.

THE INDIA REVIEW

OF WORKS ON SCIENCE,

AND

JOURNAL OF FOREIGN SCIENCE AND THE ARTS,

EMBRACING

MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS, &c.

REVIEW.

Sugar, as to the probability of an improvement in the cultivation and quality of, either through Europeans or Natives, in case of an increased demand: From the report from the select committees of the Houses of Lords and Commons, appointed to enquire into the present state of the affairs of the East India Company. 1830-31.

Bell's Comparative View of the External Commerce of Bengal, during the years 1834-35 *and* 1835-36, *pp.* 106.

A Treatise on the Cultivation of Sugar-canes, and the manufacture of Sugar, comprehending instructions for planting, and saving the cane, expressing the juice, &c. &c. By W. Fitzmaurice, *many years a planter in the island of Jamaica, pp.* 69, 1830.

The nature and properties of the Sugar-cane, with practical directions for the improvement of its culture and the manufacture of its products. By George Richardson, *Porter Philadelphia, pp.* 354, 1831.

From a remote period the natives of this country possessed the art of making sugar on the exact principles of manufacture pursued with so much success in the West Indies, and we learn from the work by Mr. Fitzmaurice that, on this account, the Court of Directors ordered, in 1792, a report to be drawn up on the subject, which was printed in that year by Debrett. From this report we find, that sugar, ever since the accession of the British to the territorial jurisdiction of Bengal, was a capital staple commodity, and drew annually into these provinces specie to a very considerable amount, which was wholly expended here in the purchase of that commodity for exportation, principally to the ports of aliens on both sides of India. We should have supposed that, under such favorable results, the sugar trade of this country never would have declined, but its history shows that the trade had been lost at a late period, the current totally reversed, and immense treasures exported hence, for the purchase of the same article in foreign ports. On referring to the Bengal Consultations, Revenue Department, 5th of June, 1776, it will be found that the sugar trade had so alarmingly declined, that an address on the subject was presented to the Government of that period, by persons evidently conversant on the subject. The export had then ceased, a neglect of the proper system of manufacture was the result; for the peasant or ryot had few wants, and the raw cane, or a viscous juice expressed from it, supplied all his wants for temporary aliment or indulgence; the juice being boiled into a syrup, and of a quality adapted for making the coarse kind of sweetmeats, supplied the demand. This syrup, called *Gour* or *Jaggery*, was however plentifully exported to Europe. Now

can it be credited that the British policy in India led to the neglect of so important an article of trade, of such essential importance to the public revenue, and not merely for use in the state in which it was exported hence, but as a material for the great, opulent, and valuable body of sugar refiners, with reference to whose interests it ought to have been chiefly viewed. The quantities of sugar imported into England for a series of years previous to 1792, the period to which we are now adverting, prove that nearly two hundred and seven millions of pounds weight passed through the hands of the British sugar dealers yearly; and it was demonstrated that, on an average, one third of the whole of that quantity has been consumed within the British islands, one half of the other two thirds, exported to dependencies, and the other third, after undergoing the expensive operations of refining, wholly exported. So that, supposing no more to have been refined than the complete one third, exported in that state, how necessary was it for the administration here, and particularly the merchant, to have known that the sugar of India was not of sufficient strength through the defective manufacture, and that it opened the markets for the direct and circuitous introduction of the more rich and yielding sugars of the French and the Americans.

But this was not all; the Chinese and the Dutch took advantage of this want of foresight in the Indian Government. The industry and ingenuity of the former especially, brought the manufacture of sugar to a state of the highest perfection and supplied the deficiency. Without occupying much space, we have endeavoured to prove that the Government of this country shut its eyes to a means within its power of enlarging its own resources, and of giving occupation and wealth to its peasantry, by a profitable exportation at a moment when a concurrence of unusual events in the West Indies and in Europe threw open the British markets with considerable and unprecedented advantages to the East India speculation; when, in fact, the failure of the French sugar colonies, the abatement of the produce in the British, together with the popular prejudices raised by the numerous advocates for the abolition of slave trade, had caused East India sugar of a very inferior quality to meet a reception and sale.

But a new era has now dawned on India. Mr. Bell has already shewn that England will be under the necessity of drawing upon India for new supplies of sugar. The political aspect of our West India colonies tends to strengthen this impression. The shipments, during the last year, of nearly nine thousand maunds of sugar from Calcutta to North America, is evidence of deficiency somewhere; and, as Mr. Bell justly says, it is obvious that free labour in the West Indies, without taking into account the immense sacrifice already made to rescue it from the stigma of slavery, can never be brought low enough to compete with that of the Hindoo. Hitherto the people of England have been made to pay an enormous sum, to indemnify the West India planters for the loss of their slaves, and in return for this boon the people have been compelled to purchase the produce of the East at a much higher rate.

The monstrous injustice, however, to which Mr. Bell alluded when his work was published, of bolstering up the interests of one country at the expense of another; the maintenance of the unnatural price of sugar, by means of unfair restriction, now no longer exists; and the day has arrived when England must look to this country for her only source of supply.

We shall now proceed to examine the various reports before us to prove that the quality and manufacture of sugar may be brought to a state of the highest perfection in this country. Mr. Bell shews satisfactorily that the Otaheite or Mauritius cane does not degenerate in India under common care, the produce of which is quadruple that of the indigenous. He states that, under the direction of the Agricultural Society, it is expected that within four years the

country cane will be completely displaced— a prospect the most encouraging to our commercial community here. We shall therefore, with the ample materials in our possession, proceed to consider the cultivation of sugar cane in India. Mr. Fitzmaurice, who was many years a planter in the island of Jamaica previous to his coming to the East, observes that the ground intended for the cultivation of sugar cane must first be cleared of all shrubbery and grass, the roots carefully stocked up with hand-hoes, ploughed over once or twice, and levelled for laying out the whole into pieces of thirty, fifty, and seventy biggahs ; along these pieces it will be requisite, for the purpose of draining, to form a strait commodious trench on each side, at least four feet wide at top,

"Four feet deep, and proportionably narrow at bottom, that the banks may be sloped so as to prevent injury to the sides of the trenches in the heavy rains, which would, if the sides were dug perpendicular, occasion the banks to fall in, thereby obstruct the passage of the water, and require continual labor in repairing them.

The mold dug from the trenches will help to raise the internals, and make paths which should be formed, for ease, convenience, and dispatch, in carrying the cane to the works.

The main trenches must be eight hundred yards from each other, and thro' the centre of the plantation, according to its extent, there should be cross trenches of the same dimensions as those on the sides of the pieces, into which the latter should lead ; and as the water will find its own level, its direction should govern the line of the main trenches, to which the inclination would be easily found or made by the same means.

When the ground is thus prepared, it should be laid out in beds of twenty feet wide ; or, if it is high ground, thirty feet beds will be preferable ; from a trench of two feet in width and depth between each bed, the mold of the trenches will raise the cane beds in the middle, and the rubbish collected in them taken out from time to time in hoeing and weeding the cane, will contribute to manure and raise the beds, so that they will be found sufficient to convey all the superabundant water to the main trenches, as will be required when the rainy seasons are severe.

The soil of Bengal being low, it is very requisite that the ground should be carefully drained, some time before it is planted ; for that purpose, therefore, a gang of sixty laborers ought to be hired to do this ; they may in a fortnight, dig and lay out all the trenches and intervals of a plantation of five hundred biggahs ; but this should be completed some considerable time before the heavy rains set in, or the commencement of the regular planting season, in order that the trenches may be strengthened, hardened, and durable ; if this is done in time, the drains will afterwards continue in good repair, by cleaning out as often as the plantations are weeded ; and at the same time the manure acquired in the drains will raise the beds in the centre, nourish the cane roots, and render the soil productive to a degree that cannot be without experience easily conceived or credited.

When the plantation is thus far prepared, have it ploughed, the trenches cleaned, and the pieces marked off, from one end to the other in the following manner ; prepare a line of a sufficient length, and affix thereto, at every seven or eight feet distance, a piece of colored cloth, like a surveyor's line ; stretch this across the beds as strait as possible, so as to square with the sides, and ends of the beds ; be prepared with a number of pegs of about two feet long, place one in the earth at each of the cloth marks on the line ; this work may be performed by boys, and girls ; when the first row is lined out, let the *liners* retreat about three and half feet, and line and mark another row, like the first ; still retiring three and half feet, till they have lined the whole piece ; when the liners have marked off the first-row, the laborers may commence the digging of that row ; four smart boys or girls may line, without fatigue, three biggahs per day ; with two or three more to collect the pegs, as fast as the holes and banks are formed by the laborers.

Much care and some pains are required, on the first laying out the ground, for trenching and holeing ; it ought to be carefully drained, the beds shaped, and planted in such a manner, as that the superabundant rain water may drain from the cane beds, into the trenches, so that the canes may not be chilled, or injured by stagnant water, or too great a quantity of it, as it will contribute to the excellence and quantity of the crop, if the ground retains only an equal share of moisture throughout, to promote the spreading of the plants in vegetation ; each stock planted in this manner properly managed, will give twenty or more canes ; a single cane alone is produced from the root planted after the careless and improvident method of culture in Bengal.

Should the land be high, let the liners begin at the top, and line it in an oblique or winding direction, gradually to the base ; the farmer who feels the spirit of cultivation, who will see his ground carefully prepared and planted, in his yielding, will find himself amply compensated for his trouble ; three biggahs will contain about three thousand five hundred holes, three feet and half wide, the canes from which will yield on a fair average properly manufactured a ton and half of sugar ; but it cannot be too much attended to in this branch, that the ground must be well ploughed, the earth pulverised, and carefully planted; fifty coolies can with ease, even in their mode of working, turn up three biggahs

per day, and half that number will prepare an equal quantity, when familiarized to the use of a mold plough, wherewith they can form the cane furrows and afterwards it will require only a few hands to shape the banks, clean out the furrows, and preserve the whole in an orderly condition.

When forming the banks, and furrows for planting, the earth must be dug in rows about six or eight inches deep, until they each shew an even pretty bank from one end to the other; then let the laborers fall back to the second row of pags, and so on till the whole piece is dug into narrow ridges, and strait and even trenches, which will appear, if properly attended to, square, parallel, and regular.

It is recommended with the foregoing method to have the laborers employed by daily task-work; the employer, or a steady well tempered servant as overseer, or steward, to visit them often, and the owner as frequently as he can, to see that the work in every department is well, neatly, and exactly performed.

The soil, if newly turned up for cultivation, will require no manure, but if in any degree impoverished by repeated tillage, it will be found more productive if slightly manured for the growth of the sugar cane; this part of the planting business in Bengal will be found very easy, on account of cheapness of stock, and of labor; and as that best and most productive method of enriching a soil, will be so easily effected here, the construction and use of moveable penns are worthy of adoption;—with bamboo posts and rails form a number of light frames, which may be bound to each other as a fence, sufficient to enclose about two biggahs of ground at a time; by removing the penns at the end of one week, one side of the penn to stand, and the two sides and the other end to be carried forward, and forming the penn on the outer or opposite ground of the standing part of the fence: thus the planter can go gradually thro' his whole estate feeding, manuring, exercising his cattle, and following all up with turning up his soil for tillage.

The stock should be fed every night with grass, or vines, and in crop time with cane tops, which are then plentiful, an hundred head of cattle will amply manure, with their dung and urine, be the soil ever so impoverished, an estate of five hundred biggahs.

The plantation should be divided into three separate parts, the first to be in manure and preparing for the *fall plant;* by ploughing up the penns as they are so manured, the earth will be duly pulverised and in proper order, against the rainy season in time for planting; the second division should be under cane to cut for the succeeding crop; and the third division under *rattoons*, or roots of canes, which if moulded up, and hoe-ploughed between the roots when young, will produce nearly as much sugar as the plants; but should the soil be too poor to support rattoons, let one-third lay over as fallow, and the other two-thirds under fall and spring plants for the ensuing crop; if the rattoons are moulded up, and manured with rich earth from tanks and ditches, as they spring up after cutting, they certainly will be found deserving the attention and care of the cultivator; the juices of rattoons are much richer than the juices of luxuriant plants, and on that account, both are mixed in crop in order to improve the sugar.

Moveable cattle penns afford the most easy, and certain mode of enriching, and nourishing the soil for the growth and culture of sugar; repeated experience in Jamaica has proved it; and the farmers of Wiltshire who manure their fields by forming sheep-walks before ploughing in that manner, which they call flying penns, improve their crops very considerably; but whether the soil is poor or not, it is recommended to the Bengal farmer to collect all the cleaning of his tanks, as well as all the manure about his yard, and heap it up at or near the centre of the plantation, so that it may be convenient whenever it is required; the manure heaped up should be covered from the sun with rich mold, to prevent the exhalation of its richness, and to keep the salts with which it is charged alive, the ricks or heaps should be at times mixed and chopped up with hoes.

As the seasons are usually regular in Bengal, the ryots may begin to put the canes in the ground a week or ten days before the time the rains usually fall, and they will experience and derive from this practice considerable advantage, as the young plants will immediatly shoot up with the first showers.

The part of the canes that ought to be preserved for plants, and indeed the only part fit to plant, is the green watery cane top, with a few joints, which is unfit for manufacturing; if the ground is in want of manure, which the farmer will be the most competent judge of, from the appearance and stunted growth of his canes, or if his land is exhausted from frequent cultivation, recourse must be had to his heaps of manure; laying it slightly in small quantities in the holes as he plants the cane, or round the cane roots as they come up; about twenty weight or about two Bengal bullock loads dung to every hundred feet of rich mold taken out of ditches or tanks will be found a salutary and nourishing manure.

Should any white ants be observed in the ground under preparation for planting, or should they make their appearance after the canes have begun to vegetate, the most effectual mode of destroying them will be by poison,—in this manner, take a small quantity of arsenic, and mix it up with a few ounces of burned and pulverized ship bread, oatmeal, flour, or ripe plaintain, let this be mellowed with a little molasses, avoiding cautiously while handling it the noxious effects by breathing too near it when mixing; or lest the wind should blow it into the eyes; place the size of a turkey egg of this composition upon a flat board, covered with a wooden bowl, and place several of those bowls with the mixture in different parts of the plantation; the ants will soon take possession of the

wooden vessels, and the poison will have a general effect, for those ants that die, being always eaten by the others, the whole estate will be effectually cleared of white ants; this mode never failed of destroying white ants, during sixteen years in the West Indies; rats will likewise be destroyed by similar means, mixing a little arsenic with ripe plantain or parched corn, ground and tied up in plantain leaves will be effectual; rats are very destructive to a field of cane, but when the poison is once taken, it is as effectual as if the animals were destroyed, for vermin of every kind will afterward shun the plantation.

Chunam, where white ants are few, will help to destroy them, a small quantity of it thrown over or under the canes, when planting, will preserve them from these insects."

(*To be continued.*)

Art. II.—Notes on Persia, Tartary, and Afghanistan. By Lieut. Col. Monteith, K. L. S. *of the Madras Engineers.—Madras Journal of Literature and Science.*

Defence of British India from Russian Invasion.

By Captain C. F. Head, Queen's Royal Regt.

We promised in our last to notice the opinion of Col. Monteith on the much agitated question of Russian invasion of India, and at the same time we may consider the opinion of Capt. Head, on the defence of British India against Russian invasion, as being subjects at this moment of commanding interest. We must confess that we have long watched with alarm the apparent indifference of the British Government in India to the insecurity of our position, and to the numerous federal native powers that are ready to rise against us at the call of any invader who may raise his standard and invite them to combat. The British policy of India has been directed during the time of peace more to paltry reductions and to miserable systems of false economy, tending to diffuse a spirit of discontent among the very persons whose affections and devotion to her rule should have been conciliated and secured. The proper policy was to have strengthened her frontier, to have increased her internal resources, and to have brought these magnificent dominions by steam navigation nearer to Great Britain, to derive her assistance by rapid communication when one might most require it. But our forces are crippled, our arsenals imperfect; and if a sudden rise was proclaimed, we question whether we should be ready within six months to shew a proper front to repel our assailants. But the day has arrived when we must be on the defence of our vast territorial wealthy possessions. Russian ambition threatens, internal disaffection prevails: and now is the time for the supreme Government to assume another and more masterly policy, and buckle on its armour;—to conciliate the affections of the brave men who have fought and won the country. Instead of sowing disaffection among its civil officers, by the reduction of salaries to which, by long established usage, they are legally entitled, let good faith and unity of heart and good-will pass from the governing to the governed, let our frontier show a strong line of defence, war *materiel* be supplied, steam communication be established, and the Indus and Sutlege navigated. Then let all Russia, Caubul, Nipal, and Burmah advance if they dare! Col. Monteith observes that a great state will continue to gain on the savage tribes on its frontier, is but the usual course of things, and one which, our author is of opinion, nothing can long prevent.

"On once passing her present limits, she must fix her new frontier line either on the Sir Derria, or on the Oxus, as on the banks of these rivers only can she find lands, or even water, for the support of the frontier posts. The Oxus presents so many advantages over the other, that I cannot suppose there will be much hesitation on the subject. This river is navigable for boats from the mountains of Baduckshau to the sea of Aral; the power commanding its banks must exercise a great influence over both Persia and Afghanistan. For trade alone this would be a great object, and probably the one now really aimed at; and, in the first instance, Khiva will be occupied, and probably colonized with Cossacks or Tartars from Russia. Some advantage in point of territory will be, at the same time, offered to Persia and Bokhara. Under no circumstances can Khiva expect aid from the surrounding states; she has too deeply injured every one, to expect any thing but enmity from her neighbours, and her own power is totally unequal to any effectual resistance. With Bokhara a good understanding will, if possible, be established.

From this position, in the event of a quarrel with England, by demanding a passage for troops, assembling soldiers, and making a a shew of invasion, Russia would threaten our possessions, and oblige us to make preparations against her, besides keeping embassies in the neighbouring states."

Col. Monteith, however, does not think that Russia for some years would be able to make any serious attempt or permanent impression, "*except through our own negligence*." Most true; but where is the political observer in India who would say that British policy has been anything else than downright negligence?

"The aid of Russia would without doubt be eagerly courted by the different families now disputing the possession of Afghanistan, and repelling the Seiks; or Persia would be happy to avail herself of their aid to recover Herat, and her former possessions in Khorasan. But it is useless speculating on the probable conduct of a state, which has every chance of falling into anarchy, and being incapable of any efficient external exertion. Civil war may bring forward some bold and able chief, like Nadir Shah, who will soon change the political state of his country."

The present state of affairs in Persia will now induce our readers to look upon the foregoing as a striking illustration of the position we have taken up; and we will venture to say that Col. Monteith himself will look upon the state of affairs in that country as most inimical to British security. With respect, however, to any enterprize of Russia, either actually to invade or to threaten our possessions, Col. Monteith observes that

"The route by Tartary is, in my opinion, preferable. The line of her operations can be secured, from Orenburg to the banks of the Oxus, by her own Tartar subjects; she can convey the necessary stores and supplies the greatest part of the way by water, with the same facility we ascend the Ganges, or greater, as the current in the former river is less rapid than in the latter. Her army will be perfectly free from all fears regarding the conduct of Persia, where the most trifling circumstance might bring on a rupture with the tribes who care but little for the royal authority, and which no precaution can always prevent. The length of the march would most materially be diminished, and the extent of desert to pass not much increased. One flank of the army will be covered by the double barrier of a great river and considerable desert; and the force which under all circumstances she must leave at Khiva would suffciently protect her against any attempts of Persia, even if she were inclined to oppose the enterprise; in fact she could have nothing whatever to do with that kingdom.

On ascending the Amoo, or Oxus, to the point nearest Balk, a considerable corps must be established in an entrenched position, and the real land journey commenced, entirely through the countries subject to the Afghans. Their own vast empire, and the parts of Tartary through which they will have passed, abound in camels, horses, and other cattle, so no difficulty need be anticipated regarding carriage. Balk is a considerable province where provisions would be obtained, and the country between it and Cabul, with the exception of the Hindu Cush, is partially cultivated, and generally travelled by caravans and numerous bodies of people."

Here commence difficulties, but our author proves them to be imaginary. He acknowledges that they might have been deemed insurmountable, had we not seen Nadir Shah overcome them with the greatest ease, and in a short space of time, even when the Afghan monarchy was in its power. The actual state of the country, therefore, in our author's opinion, favors the enterprize.

"Herat, and the principal part of the great tribe of Dooraney, still adhere to Kamraun Mirza, or any other member of the Soddozye branch, whilst Candahar, and the principal of the other provinces, are held by Doost Mohamed Khan, chief of the Baurikzyes division of the same tribe (Dooraney). He again, is pressed on his eastern frontier by the Seiks. It appears to me, negotiation could hardly fail to gain the assistance of one or other of these chiefs. By the aid of her army the Afghans would probable soon recover all they have lost by their internal dissensions, and it would be equally certain of crushing the opposite faction. So supported their march to the Indus appears to me, though difficult, not doubtful."

Let then those, who sleep in their supposed secure permanent Indian possessions, weigh well the opinion of one whose long residence in Persia and familiar acquaintance with the principal authorities in that country entitle it to respect; and say whether the present system of government is calculated at this moment to meet the incursion of such a powerful enemy.

"In forming an opinion of the probable result of the approach of an army, by the route I have mentioned, it is necessary to take into particular consideration, not only the political relations which exist between the Afghans and their neighbours, but also the peculiar formation of their government, which materially differs from that of the surrounding countries. The great tribes of Afghanistan more resemble an alliance of

separate independent states, and those of a most democratic form, than the despotic kingdom of an Asiatic sovereign. This kingdom has not been sufficiently long established, to allow the sovereign to divide, and break into different clans, these formidable bodies, who have, in the space of one hundred and thirty years, three times changed the dynasty.

The Ghilegies, in the early part of the last century, under Mir Veis, revolted from Persia, conquered it, and held possession, till expelled by Nadir Shah, who again fully revenged the injuries inflicted on his country. After his death Mahmood Shah and Zeman Shah both reigned in Afghanistan, from the Soddozye branch of the Dooraney, and Doost Mohamed Khan, chief of the Baurikzyes, now promises to join the same station. The power is too equally balanced, for any chief ever to exercise more than a nominal authority over any but his own tribe. The towns, and some lesser tribes, who have not power to resist the particular one of which the king may be the head, are all he can really command. So full and admirable an account of these divisions has been given by Mr. Elphinstone in his journey, that any thing I could say would only be a repetition of his observations, with far less pretensions to correctness. My information was chiefly derived from some of the exiled chiefs, who were at the Persian court, and resided there nearly from the time Mr. Elphinstone had been in their country, and I only give the following list to shew the strength of the leading tribes. Besides there are many smaller ones, who altogether amount to a considerable number, and generally follow the fortunes of the ruling party, being equally oppressed by all, with little attachment or fidelity to any. Such a state can muster a most formidable power for foreign invasion, and the conquest of the neighbouring countries is much easier than the establishment of a firm government at home.

Great Tribes of Afghanistan.

Of Tartar origin.	Eimuks........	Families 80,000	about 400,000 souls.	
	Hazarahs..........	70,000	350,000	
	Usbecks tribes of....... Balk....	200,000	1,000,000	
	Eusofzyes..........	150,000	750,000	Shah Kamran Mohamed Shah,
	Dooranies............	130,000	650,000	Sha Shudjah.
	Deduct Baurikzyes.....	50,000	250,000	Dost Mohamed Khan's.
	Ghilgies................	100,000	500,000	Tribe of Meer Vois and the conquerors of Persia.
	Turcolanies...........	20,000	100,000	
	Upper Momunds	10,000	50,000	
	Kyberies	25,000	125,000	
	Peshour tribes about....	350,000	1,750,000	But divided into a great number of small tribes, therefore subject to the government.

There are a great number of smaller tribes, particularly on the mountains, whom it would be needless to mention. I was entirely guided in my enquiries by the Honorable Mr. Elphinstone's account of the country, and found a perfect confirmation of his statements. The fixed inhabitants even become subject, within the limits of the tribes, to their chiefs, so but a small portion of the actual revenue reaches the royal treasury.

The Afghans have been only known, as an independent state, since the beginning of the last century, and their empire then was formed by several provinces severed from India and Persia. They were again subdued by Nadir Shah, who, had he lived, would certainly have broken the union of the tribes. He had marched some large bodies into Persia, and intended planting them on the Turkish frontiers, filling up their places with Persians. Assad Khan he had actually taken to Erivan, and orders had been issued for 100,000 families to be removed to Kurdistan, and the Kurds, and other ill-affected subjects of the Turkish frontier, to go to Afghanistan. On his death Assad Khan quitted Erivan, and forced his way, with great talent and courage, to his own country; he had about 5,000 men.

The tribes of Persia have been for ages under a despotic government, and at times one of great power. The chiefs have been obliged to frequent the court, enter into its intrigues, and expend in the capital the funds which enabled them to preserve their ascendancy, and make the men under them efficient.

The King also fomented the dissensions among the sons and relations of any very powerful chief, whose tribe has thus been divided into several branches, and the first opportunity taken of removing them to distant parts of the country."

It is these internal dissensions which are in favor of the Russians; in whatever country they may exist, that country is weakened by them. It was these arising from conflicting interests and different castes, that invited a foreign power to conquer India, and which brought the people finally under our rule. This state of things in Persia favors the ambitious projects of Russia.

"Regarding the invasion of India through Persia, I will only say a very few words—the

subject having already occupied the attention of Government and the diplomatic agents, for these last thirty years, and the fullest details, in consequence, having been furnished.

From all the experience I have had, in eighteen years' residence in Persia, I am perfectly persuaded that, if the government of that country were sincerely to aid a Russian army, there is no obstacle to its advancing as far as Herat or the Afghan dominions. In fact this space has been passed many times during that period, by larger bodies of men than the army ought to be composed of; under the circumstances above mentioned, it is supposed that Persia will be in alliance with, and aiding, Russia. All the troops it would be advisable to have as her contingent, ought to, and might, be collected in the province of Khorasan. To reach this, the best and shortest route, for the heavy part of the force, is from Astrabad up the Goorgan, and, through the country of the Khorasan Kurds, to Meshed. The next point to be gained is Herat, which will not be a very difficult task. As far as this place the population is favourable, being old subjects of Persia. From this they must fight their way to the Indus, for it cannot be supposed that any thing they can offer will induce the Afghans to part with their western provinces, the possession of which alone can be a supposed inducement for Persia to enter heartily into such a war. The enterprise is practicable, but difficult; armies have passed three times by this route in the last hundred years. Persia is not, at the present moment, in a condition for any power to put confidence in her political relations. Though the present king has certainly gained the throne with less difficulty, and in a shorter period, than could have been expected, he cannot be said to be firmly established, and in the event of any reverse, the people generally, who are far from being attached to the Kadgar dynasty, would probably revolt. He has besides killed Mirza Abul Kassim, his able prime minister, to whom he chiefly owed his success, who, with all his faults, and they were both numerous and great, was, without doubt, the ablest man in his court or in that of his father. The Azerdbijan troops, by their conduct in the civil war, and in Khorasan, have shewn of what excellent materials the Persian soldier is really made, and that the trouble taken by the English in their organization, has not been thrown away. If they failed in the war with Russia, it was from no fault of theirs, but what results from all irregular government, when no fixed system of war or policy can be depended on."

Such is Col. Monteith's opinion on this important question: we now proceed to notice that of Capt. Head's.

(To be continued.)

Art. III.—Cursory notes on the Isle of France, made in 1827; with a map of the Island: by E. Stirling, Esq., *Member of the Asiatic Society,* 1833. *Calcutta.* Thacker & Co. *8vo. pp.* 50.

(Continued from page 321.)

Mr. Stirling proceeds to give some interesting and important remarks on the population of the Isle of France. In a colony of such small dimensions, the population consisted principally of slaves, many of whom had, however, been emancipated by grateful masters. In 1776, Abbé Raynal estimated the population, the military force inclusive, as follows:—whites, 6,386—free negroes, 1,199, and slaves, 25,154, or total, 32,739. In 1799, Baron Grant estimated the population at 10,000 whites and mulattoes, and 55,000 slaves, from which it is to be inferred that they had doubled in the twenty-three years preceding. A third estimate was made by the author of the Voyages des Orientals, who found, in the year 1818, that the inhabitants amounted to 80,000 slaves, and 15,000 whites. Our author found the following calculation correct at the period of his enquiries.

1.	500	Houses,	Planters, at per house 7 individuals,......	3,500
2.	60	,,	Merchants, Agents, &c. &c. at 6 ditto, ...	360
3.	350	,,	Shop-keepers, retail dealers, ...	1,550
4.	50	,,	Artificers, Mechanics, at 5, ...	250
5.	100	,,	Dancing-masters, players, music masters, and instructors of all kinds, at per house 4,..........	400
6.	100	,,	Carpenters and individuals employed at the Harbour, at 5,	500
7.	500	,,	Mulattoes employed in various ways, beside the above, at 6, ...	3,000
8.	1,000	,,	Free Negroes, at 3, ..	3,000
9.	150	,,	Malabars and Indians, at, 5, ...	750
10.	350	,,	The Police, Government Establishment, and officers; the Judicial Courts and the Servants of Government at 5, ..	1,750
			Temporary Sojourners,	800

	Children not included in above, ...		1,500
	Registered Slaves, ...		58,000
3,160	,,		75,360
	To which may be added, the Troops and dependents, ...	2,500	
	Indian Prisoners, 300, and Government Slaves, 400, ...	700	3,200
			78,460

The population may be divided into the several obvious classes, for the sake of having a distinct view; and the following may be considered as shewing, as nearly as possible, the different portions of it, according to their numerical strength:

Slaves, ...	58,000
Mulattoes, ...	10,640
Whites, ...	3,670
Children, ...	1,500
Sojourners, ...	800
Free Indians, ...	750
	75,360

I have been obliged to calculate the number of individuals in one house variously, as I thought would be most agreeable to the actual state of the case. As the women are very prolific, and, generally speaking, rear large families, I am not sure that I have been sufficiently large in my estimate. The children are, moreover, very healthy, and few die early. After some deliberation, I have assigned seven individuals to houses possessed by planters, as they live in comfortable circumstances, and their families are almost always very considerable. On the other hand, I have only allowed three individuals to one house inhabited by free Negroes, as I believe the produce of black parents is not generally such as to warrant a higher rate.

The encouragements to population are by no means small; many circumstances tend indeed to promote it to the last degree, although it must be confessed, sometimes by means which are in opposition to good morals."

Our author, on the subject of laws of marriage, considers their moral and physical effect, with reference to the influence of the climate on the inhabitants and their offspring,—a subject, it must be confessed, of great importance, and one which will, no doubt, excite the interest of our readers in this country. It appears that the laws of the Isle of France are particularly tenacious and positive on this subject. Europeans are prohibited marrying those who are born on the island, of slave extraction.

"The former can only be allied to people born in Europe, while the latter can only marry those born in the country. The object of these laws is to preserve that distinction which exists between European and African blood. The nature of these laws gives rise to certain connexions between the Europeans and the Mulattoes, from which spring a race which, although not legitimate, still possess all the benefits of a legal issue, whence it occurs that illegitimate children are not subject to that degradation to which they would be under similar circumstances in Europe, and connexions of this nature are not beheld with similar severity, but are even acknowledged in public without incurring extreme censure. Consequently, illegitimacy offers no bar to a young man's prospects in life, and does not prevent his associating in society; therefore, the feelings of society not being outraged, children of such an origin are well brought up, and receive all the advantages of education which it may be in the power of the parents to bestow.

Children born of European parents appear to thrive wonderfully well till a certain age. All the children I saw in the island appeared wonderfully healthy and strong, of excellent shapes, and every attention appeared to have been bestowed on their being kept clean and well dressed. The mothers seem to perform every office of kindness towards children, and none perhaps in any country can be more wrapt up in their welfare. The climate of the colony being extremely temperate, and not subject to an excessive continuance of heat, and only enjoying an agreeable degree of coolness in the winter season, is to a considerable degree favourable to the longevity of the inhabitants, and no where in a climate in the torrid zone, are such a number of elderly people met with. I have frequently met the grand-children dining at the same table with their grand-mother and grand-father."

We have on a former occasion alluded to warm climate being congenial to infancy: we learn from Mr. Stirling that it is the case in a remarkable degree at the Isle of France.

"They as well as the children of Mulattoes have very precocious talents, and receive their learning with a degree of comprehension and quickness unknown in Europe."

This is precisely the case here; but we fear that the impression from education is not so permanent as it is in Europe. This, probably, may be owing to a want of that conversation among literary and scientific men, with whom civilized Europe abounds. Alluding to the females, our author says,—

"They possess a degree of vivacity, and excellency, and beauty of shape, not often exceeded. Their features, however, it must be confessed, are not so engaging as their forms, as the muscular necks and peculiar heads, if not large features, often intimate the stock from which they have sprung; however, in some

cases, where several generations have intervened, these marks of their ancestorial blood have nearly become obliterated, by a considerable regularity of features, and by a most lively and pleasing expression of face, in which no one is inclined to search for objections. Subsistence appears to be sufficient for the purpose of encouraging the progress of population, and the demand for labourers, and the high wages, call forth every individual to some certain employment, with the full assurance of an ample reimbursement."

As a cause of the increase of population, Mr. Stirling is of opinion that the price of labour tends to propel the increase of inhabitants: while all European articles are sold at a moderate price, the common necessaries of life are extremely high. The effects of the French revolution, the subsequent war and inadequate subsistence arising therefrom; the emigration on the introduction of the British rule; a dreadful fire which happened in 1816, and burnt down the whole of the town, and a hurricane which happened in 1818, have however been checks which the population has received. Mr. Stirling says that for muscular or physical capabilities the slaves are not to be excelled; they possess limbs remarkable for their sinewy appearance. Four or five of them draw a cart, which could not be moved by less than two pair of bullocks. They are in the habit of dragging these carts about the town of Port Louis, with all sorts of merchandise. The following are our author's remarks on the Creole progeny.

"The Creoles are often wealthy, engaged in beneficial occupations, moderate in their desires, and are viewed with indulgence; and, where ties of affection exist, enjoy the happiness of relationship and preference. They are amiable and agreeable in their manners, unassuming in their intercourse, and in their education, both the men and women have opportunities of becoming useful and pleasing members of society. The former have a college opened to them, where English, Latin, French, Mathematics, &c. &c. are taught by excellent masters; and the latter are taught to perfect their natural taste for music and dancing, of which they are passionately fond, to the fullest development. They likewise become good mothers and respectable housewives, are remarkably fond of their children, and their domestic arrangements are regulated with the greatest economy, combined with much liberality in their living, and hospitality. The Mulattoe population is much greater than the European portion, and on actual inquiry, I have no doubt their numbers would be found very considerable. They form the centre, the slaves the base, and the Europeans the summit of the pyramid of the population of the Isle of France."

Mr. Stirling observes, on the subject of law and police, that the former is that prescribed by the French. The Code of Napoleon, in Mr. Stirling's opinion, furnishes a clear, precise, and easily-understood set of regulations for the civil government of the colony, and seems well adapted to the customs, manners, and sentiments of the inhabitants in general. The public duties are well conducted, the subsidiary arrangements being formed and managed with considerable judgment and energy.

"There are two civil courts, or what amounts to two; that is, there is a court which is denominated the court of the First Instance, and a Court of Appeal: to these may be added the Admiralty Court. There are a number of Lawyers and Attorneys, who attend and labour in these courts. I am both ignorant as regards their character in respect to their learning, ability, and integrity, and as regards the nature of the suits that are brought up for decision. Litigation, although not unknown, is not, I feel persuaded, of so vindictive and harassing a character as in most other countries."

Popery is the religion generally adopted; but there is an English protestant church, at which, however, the English protestants alone attend on the day appointed for divine worship. Attached to the catholics,—

"There is a Bishop with some other high officers of that Church resident at Port Louis. The Church is perhaps the finest edifice there, and service is performed in it every morning; and on Sundays the Grand Mass is gone through twice. The churchmen are attentive to their duties, and the people appear to attend very regularly to hear and to join in the service. The Slaves are frequently, if not always, instructed to pay their devotions in this religion. All the Creoles learn the duties and ceremonies likewise of this Church; but what is somewhat singular, is, that the Malabars have become Christians, and, in the absence of their original Hindoo ceremonies, have become the adopted children of Catholicism. Such of them as are descended from Mahommedan ancestors, have forsaken the faith of the prophet for that of Christianity."

There are a number of excellent shops, furnished exactly in the European style, which are kept by Frenchmen from Europe, but more generally by Creoles born on the island: the shops of apothecaries are most conspicuous. The shop-keepers live in comfort; their dealings are for ready money only, which ensures realization of profit. The high profits are out of proportion to the risk

incurred. In reference to this subject our author observes,—

"The price of labour must be considered as high. Slaves who were sold for less than two hundred dollars a head, at the period we came into possession of the Island, are now risen to three times, and even in particular cases, to four times that amount. This may be deemed to arise either from their scarcity, or the greater demand for them. The latter I consider as the true cause, and this at the present moment is owing to the permission granted a few years ago, to import into England the sugars of the Isle of France. This admission of the product of the Island, has given a vehement stimulus to the cultivation of this article, and has augmented the value of land very considerably. Owing to the extreme healthiness of the climate, slaves may be estimated at the value of from 20 to 25 years purchase, from the time they reach a mature age for labour. If I am right in this supposition, the annual expense of a slave may be stated at about 25 or 30 dollars a year, exclusive of interest, besides the expense of his food, which, as far as I can ascertain, may have cost from three to four dollars per mensem, therefore,

	Dollars.
Annual expense of the purchase of a slave, taking into consideration the outlay and interest, say,...............	125
Actual expense for food and clothing, at $3\frac{1}{2}$ dollars per mensem,..	42
Dollars,	167

Now the average monthly estimated value of a slave, may be stated at fifteen dollars. This is however higher than what I actually found for slaves hired out, as domestic servants could be had from eight to ten dollars a head; but then I believe the care and expense of feeding them, fell upon the gentlemen who took them into their service: if so, the above calculation may be considered as approximating nearly to the proper estimate of the charge and expense of a single individual slave. Common labour being therefore so high, other necessaries and conveniences which depend on it, must likewise be augmented in price, to defray the average rate of labour employed, as, without such re-imbursement, such labour would not continue to be supplied. But if the labour of slaves bear such high premium, the labour of free men must necessarily be much higher, and more valuable. Labour here appears the principal source of wealth, and the man who can command a portion of it, ensures himself a certain degree of independence and comfort.

The high price of labour, therefore, is one of the great causes which influence the high price of necessaries and articles generally. But there is also another cause which tends to augment prices, and this is that the greatest part of the food, and all clothing, of both the free inhabitants and the slaves, are imported from distant countries; thus, for instance, the Isle of France depends on India for its supply of rice, and on Madagascar for nearly all its animal food. There is undoubtedly a small portion of Manioc, [the Jatropha Manihot.] Hogs too are bred and fowls reared, but not sufficient for the consumption of the inhabitants, and the supply of the shipping of Port Louis.

As profits must be sufficiently large to enable shop-keepers, &c. to subsist, and as subsistence, from the above detail, appears to be procured with difficulty, and attended with expense, it does not appear that they are larger, perhaps, than they ought to be to afford a remunerating price.

It may likewise be remarked that the interest of money is high, and in common transactions cannot be quoted at less than ten per cent. per annum; consequently the high prices of necessaries at the Isle of France, may be satisfactorily explained, with reference to the high rate of the wages of labour, of subsistence, and of the interest of money."

There are one or two establishments for casting and forming different parts of the machinery, used principally in the extraction of the juice of the sugar cane: the late introduction of steam engines applied to sugar mills, will tend to increase the employment of mechanics. Such is Mr. Stirling's account of the Isle of France, full of interest, and highly creditable to him, as evincing a talent for observation of men and manners, and a desire to communicate their result in a pleasing, satisfactory, and perspicuous manner.

Art. IV.—On the culture of Indigo in Bengal, communicated by G. Ballard, Esq.

On the culture of Indigo in Tirhoot.

On the culture of Indigo in Oude.

On the manufacture of Indigo, by H. Piddington, Esq.

On the cultivation of Indigo, by N. Alexander, Esq.—*Trans. Hort. Society, Calcutta,* 1836.

The cultivation and manufacture of indigo, as now practised in Bengal, have been owing entirely to the enterprize of British merchants. The cultivation covers 12,00,000 acres, and gives subsistence to about 5,00,000 families; the annual outlay for which amounts to £ 16,00,000. Besides this extent and value of its cultivation, it has tended largely to promote the salubrity of the country, from the large tracts of land it occupies, which were lying within the influence of the

annual inundations of the Ganges, unfit for any native cultivation; but so adapted for the growth of this plant, as to have raised the value of such land at least 100 per cent. Mr. Alexander states that opinions differ as to the value of the speculation in this.

There are many who consider it the safest investment of mercantile capital; while others have contended that we are fast approaching the point where production will exceed consumption. Mr. Alexander discusses this question.

"How far the increased production is met by an increased consumption; for it is obvious, that if causes exist, which restrain the cultivation of indigo, and that the average increase of production is equalled by a like increase of consumption, the speculation is in an equally flourishing state, whether the average crop be one hundred, or five hundred thousand maunds.

The opinion, that we are yearly extending our indigo cultivation in Bengal, careless of the consequences, has gained considerable credit in England, and is founded on two propositions; first, that the high prices of indigo, for the last six or seven years, have so enriched the indigo planters, that they are no longer under the controul of the houses of agency, and that, in consequence, each individual of that body will extend his own cultivation for his own advantage, without taking a general view of the effect such an increase of cultivation will have on the crop; the second proposition is, that any quantity of land, applicable for the cultivation of indigo, is procurable in Bengal, and, therefore, putting these together, they deduce, that no limits can be assigned to the quantity of indigo which will be produced.

The first of these propositions takes for granted, that we have the same indigo planters in India that we had seven years ago; all now become wealthy and independent men from the large profits on the trade during that period; this, to commence with, is erroneous; we are all aware, that, during the last seven years, numbers have annually retired with their savings, and without continuing interested in the concerns they have left. This annual secession of the wealthy leaves the body of the planters little changed; they have better prospects of realizing fortunes, but cannot be said, as far as this country is concerned, to be increasing in wealth; and most of them are still dependent on the houses of agency for support. But, even supposing this proposition to be true, and that the indigo planters are wealthy, and not to be controlled by the houses of agency, nor likely to listen to their advice; still their own interests would soon hinder them from increasing the cultivation of indigo, unless they found it profitable to do so on an extended scale; they must find land equally well suited with that which is already cultivated; for, if they cannot, and are obliged to have recourse to poorer soils, the extent of cultivation must be regulated by high and low prices. If high prices tempt the planter to increase his cultivation on land not so productive as that occupied by his former more limited cultivation, low prices will again force him back within his own boundary. It is, however, taken for granted, by those who contend for the power we possess of unlimited cultivation in Bengal, that all parts of the country are equally adapted for the production of indigo. Mr. Wilkinson, who takes this view of the speculation, in a paper published in London last year, states, "There is no question, that the means of producing indigo in India are unlimited; quite as regards any ratio to the means of consumption in this quarter of the globe, or the whole world, as things now are. The *new lands*, and *these are in abundance*, are more productive *than those in use*."

Now the foregoing assertion is made on grounds indisputably just, and adds to the opinion we have given all along as to the resources of this country. Indigo planters, generally speaking, have hitherto had little capital of their own, and have therefore laboured for others; for all their profits have gone to pay off their debts. This is not so much the case now; and we have no doubt the cultivation will be profitable to almost all engaged in it, excepting where the situation may be against the cultivation. Mr. Alexander considers the cultivation of indigo in this country analogous to the cultivation of corn in England during the time that prices have been so high. In both countries, says our author, high prices have tempted the cultivators to raise produce in poorer soils, and at a higher cost of production.

"Here, however, we have no law to keep up the price of indigo to a certain standard; and when prices fall, the planter must give up his poor soil, as the farmer in England would do, were the corn laws repealed*. The question of the greatest importance in this investigation is, whether Mr. Wilkinson is

* Many also consider that the ryot, who cultivates indigo, receives a very unequal share of its value, and give this as a further argument of our power of extending cultivation, by being more liberal in our advances to the ryot; but those who think so, only look to the large profits of particular factories, at particular seasons; if we take any average of years since the extended cultivation has taken place, and consider the certainty with which the ryot is paid, and the uncertainty of the returns to the planter, we will find that the ryot gets his fair share in most factories; indeed the fact of so many factories being unsuccessful, is of itself proof, that the competition arising from increased production has, in many parts of the country, increased the advance to the point which renders the speculation a bad one.

correct in his assumption, that "The new lands, and these are in abundance, are more productive than those in use ?" Now, if we consider this extended cultivation to have commenced in 1823, we shall find the contrary to have been the case ; and that the land occupied since that period, is not so productive as the land previously in cultivation, which consists of the *churs* in the river and its low banks, rendered fertile by annual deposit—the further we recede from the influence of the inundation, the less adapted is the soil for the cultivation of indigo."

In support of Mr. Alexander's reasoning, the analysis of the fertilizing principles of the Ganges' inundations, by Mr. Piddington, goes to prove that vegetable decomposition, in various stages, is not the chief fertilizing principle of the great tropical rivers. Mr. Piddington observes—

"It is well known, that, while the tracts within reach of the inundation preserve their original fertility, the higher soils are generally and rapidly impoverishing, and this to a degree of which few, who have not made the subject one of attention, are aware. There are some crops which cannot be repeated on high soils, unless at intervals of three or four years ; while, on the low lands, these are the only ones which are, and have been, taken for a period beyond the memory of man. Indigo is a striking instance, and the most familiar one, of what is here advanced ; and it was with a view to some improvement in the cultivation of this plant, that the following analysis was instituted. Portions of the silt, or mud, deposited by the inundations, were procured from Bansberria, near Sooksaugor, and from Mohutpore, near Kishnagur ; the analysis of each gave, in two hundred parts,

	Silt from Bansberria.	*Silt from Mohutpore.*
" Water, ...	2	2
" Vegetable matter, destructible by heat, ...	$4\frac{3}{4}$	$5\frac{1}{4}$
" Saline matter, mostly Muriate of Potass, ...	$0\frac{1}{4}$	$0\frac{1}{2}$
" Carbonate of Lime, ...	$12\frac{1}{4}$	$16\frac{1}{2}$
" Phosphate of Lime, ...	0	1
" Oxide of Iron, ..	12	12
" Silex, ...	156	139
" Alumina, ...	$6\frac{1}{4}$	$14\frac{3}{4}$
Total, ...	$193\frac{3}{4}$	$191\frac{1}{4}$
" Loss, ...	$6\frac{1}{4}$	$8\frac{3}{4}$
	200	200

The very unlooked for circumstance of only $2\frac{1}{2}$ per cent. of vegetable matter being found in these specimens, appears to exclude the idea, that this is the fertilizing principle, or, at least, that it should be exclusively so ; while, on the other hand, from 6 to 8 per cent. of calcareous matter appearing in them, (when in an extensive series of experiments, on higher soils, this was always found remarkably deficient, seldom more than 0·75 to 1 per cent.) points to the conclusion that the calcareous matter was, perhaps, the great agent, and, in as far as regards indigo, this was found, by experiment, to be the fact ; for a minute portion of lime was found to increase the produce upwards of 50 per cent."

Mr. Alexander argues that the lands within the influence of the inundation, long since occupied for the cultivation of indigo, are annually richly manured by a process which impoverishes the higher lands. As the cultivation of indigo is advanced from the banks of the rivers, land is occupied which will not yield a produce equal to that obtained in the soil renewed by annual deposits from inundation, unless the fertilizing matter washed away be replaced by manure. Our author deems it to be carbonic acid gas that acts as a powerful productive agent on the *churs* of the Ganges, and operates with the new soil annually deposited, in producing such fine indigo. The manure, when necessary, is therefore lime. The following shows the amount of crops for ten years.

" The crop of	1819,	was	1.05,000
————	1820,	,,	72,000
————	1821,	,,	90,000
————	1822,	,,	1,13,000
————	1823,	,,	80,000
————	1824,	,,	1,10,000
————	1825,	,,	1,43,000
————	1826,	,,	90,000
————	1827,	,,	1,47,000
————	1828,	,,	96,000

I divide these 10 seasons into two periods, of 5 years each ; as it is generally considered, that in the season 1823-24 the spur to increased cultivation was given ; and I may add, that, if over production of indigo was ever likely to take place, the last 5 years was the period for it. In the first period of 5 years, the difference of crops annually were as follows :—

		maunds,
1820	the crop was less than in 1829,	33,000
1821	ditto greater than in 1820, ..	18,000
1822	ditto ditto 1821, ..	23,000
1823	ditto less than in 1822, ..	33,000

This gives the greatest difference between any two years, 33,000 maunds, and the average difference 27,000 maunds, in round numbers.

For the next period of five years, the difference of the crops annually were,

		maunds
1824	the crop was greater than in 1823,	30,000
1825	ditto ditto 1824,	33,000
1826	ditto was less than in 1825,	53,000
1827	ditto was greater than in 1826,	57,000
1828	ditto was less than in 1827,	53,000

The greatest difference between any two years in this period is 57,000 maunds, and the average difference, 45,000 maunds. By this comparison it would appear, that the uncertainty of production is increasing faster than the increase of production; for, if we take the average of the crops from 1819 to 1823 to be 95,000 maunds, and the average difference of good and bad seasons to be 27,000 maunds, the average difference between good and bad seasons should be 33,000 maunds, thus:

95,000 : 27,000 : : 1,22,000 : 33,000

instead of 45,000, as already shown:—this increase may be considered to have arisen wholly from the lands occupied for the extended production of indigo. Whilst the cultivation was restricted to the lands most applicable for that purpose, the difference between good and bad seasons did not amount to much more than one-fourth of the average crop: when the increase of production took place, the difference between good and bad seasons, on the annual average increase, amounts to nearly one-half of the crop: the difference being 45,000 instead of 33,000, leaves an excess of 12,000 maunds against the average increase of the annual crop, which is 27,000 maunds, or nearly one-half."

Mr. Alexander is of opinion, from this view of our situation here, that we are not likely to extend the cultivation of indigo much beyond the demand. Since 1829, the average consumption is estimated at 95,000 maunds: during the last four years the consumption has greatly increased, keeping up with the increase of the crops. Mr. Alexander is of opinion that no factory can be called a really good one, which does not yield a profit when its produce is selling at 6s. per pound in London; and all factories not producing within this limit, will depend upon high prices for their existence. When good indigo comes down to 7s. or 8s. per pound, the increase in deliveries takes off the accumulations of the annual surplus. Our author says that the very inferior indigos have disappeared, and that the planters are generally turning their attention to the quality of their manufacture. He apprehends no injury to the trade from the great increase in the production of indigo in Madras, Java, Manilla, and South America; this country, possessing the greatest advantages in the cheapness of manufacture and excellence of quality of its indigo. With respect to its cultivation in Bengal, Mr. Ballard states that it is confined principally to low alluvial tracts without regard to soil; probably nine-tenths of the land bearing the crop is more or less under water by the end of July. The crop is therefore very precarious from the low sites which it mostly occupies, and is liable to be destroyed by annual inundations. Where such accidents do not occur, the crop becomes as profitable as any other. This uncertainty and the ordinary grain engagements lead the ryot to consider the indigo as quite a secondary product. The culture by the regular manufacturers is found expensive, and only profitable when the dye is at its highest rate. In Tirhoot the soil selected is high and light, being less exposed to the risk of rain or river inundations. The next situation preferred is where the soil is a mixture of light earth and clay,—a soil more retentive of moisture in a dry season than any other; heavy clay soils are generally avoided. Great care is taken to guard against soils which abound in saltpetre: light soil, with a substratum of sand, from 6 to 12 inches below the surface, is also to be avoided. There is scarcely any real alluvial soil in the district, with the exception of those factories situated on the banks of the Ganges and the great Gunduck. Throughout Oude the soil is light and sandy, inferior in general, for the culture of indigo, to that of Bengal, and particularly to its strong, dark, clayey land.

(To be continued.)

GENERAL SCIENCE.

CATALOGUE OF PLANTS COLLECTED AT BOMBAY.

By John Graham, Esq.

We believe this to be the first attempt at communicating any information with regard to the botanical productions of this beautiful part of the western peninsula of Hindostan. The catalogue constitutes the gleanings of a few occasional minutes snatched by our excellent friend (with whom we have spent many a pleasant hour in botanizing amid the sylvan

recesses of India) from the ingrossing avocations of his official duties. He has set an example which those who possess more spare time would do well to imitate. —*Edit.*

1. Alpinia *nutans.*
2. Achyranthes *aspera.* A common weed.
3. Asclepias *gigantea.* Very common throughout India. The natives apply the milky acrid juice to sores.

4. Asclepias *acida.* This is a rare plant: I found it last August (1834) on the plains to the south of Aurungabad; also in the neighbourhood of Poona.

5. Asclepias *annulare.*
6. Asclepias *formosissima.* I have only seen this species in gardens, but, I believe, it is a native of India.

7. Asclepias *odoratissima.* This too I have only seen in gardens, and very rare.

8. Amaryllis *Zeylonica.* A very beautiful plant; I do not think it is to be found within this neighbourhood.

9. Asparagus *falcatus.* Large bushes of this shrubby species are common in the Deccan; it requires support and is generally found overtopping some other shrub; it is rather a pretty plant.

10. Aloe *littoralis.* The fibres of its long leaves are extremely tough and might be used in making cord, if not cloth; however, I am not aware of its being applied to any economical uses.

11. Anacardium *occidentale.* Cashew nut; common in Salsette and on the island of Bombay, &c. The apples are seldom used, indeed they are not worth eating.

12. Adenanthera *pavonia.**
13. Adenanthera *aculeata.*
14. Averhoa *bilimbi.*

15. Averhoa *carambola.* Both species are common in gardens, and the fruit is used for making tarts. The fruit of bilimbi grows from the thick branches and often from the stem of the tree in a singular manner, like the jack fruit. The carambola is called *kurmul* by the natives, a word which signifies sour or sharp tasted.

16. Argemone *Mexicana.* A common weed, if not a native, it is, at least, completely naturalized.

17. Alangium *6-petalum.* Grows on Elephanta.

18. Anona *squamosa.* Custard apple, very common throughout India. The fruit is used as an article of food by the natives in times of scarcity; it is produced in great abundance with the slightest care; the tree seems to grow indifferently on all soils and situations.

19. Anona *reticulata.* Bullock's heart, so named from the shape of the fruit, which is also eaten, though it is inferior to the custard apple. The flowers have a very sweet smell, something like the finest flavoured pears. This species is not nearly so common as the other. It is generally to be found planted near temples along with the other species. They call them *ram vhool* and *ceta vhool*, in honour of a heathen god and goddess; vhool means flower.*

20. Adansonia *digitata.* This tree appears to be naturalized. Several of them grow on Bombay Island, throughout the Concan and in Guzurat. I do not think any use is made of the fruit; the tree assumes a very fantastic shape, the trunk very short and rapidly tapering; it attains a great size.†

21. Abrus *precatorius.* A climber common in the hedges and jungles; when the pods open and display its red bead like fruit, it looks very pretty. The natives use the seeds for weights, and call them Gooneh.

22. Artemisia *Indica.*

23. Aristolochia *Indica.* This is a rare plant, with dingy looking flowers and leaves. I have found it on Malabar hill and Cross Island in the harbour. Humboldt tells us, the South Americans use the flowers of some of their gigantic species for hats.

24. Artocarpus *incisa.* Bread fruit tree. I only know one tree on the island, it grows well and produces fruit, of some of which I have eaten. In times of scarcity it would be an invaluable tree, and as the soil and climate appear to suit it well, it is a pity that it has not been commonly planted. Its congener the jack fruit (*A. integrifolia*) is in common use among the natives, who call it *Plumus*, and the wood of the tree is more used than any other for making household furniture. The tree attains a large size in Malabar; I have seen a single fruit larger than the largest turnip at home. When growing on the stem of the tree it has something the appearance of a hedgehog stuck to it.

25. Amaranthus *tricolor tristis, oleraceus,* varieties, I suspect; *bajee* is the native name, red, green, and variegated. They are extensively cultivated and eaten like spinage.

26. Arum *campanulatum.* Native name *soorun.* The root somewhat resembles a pine apple, but it is globular. It is used by the natives instead of yams; I have tasted it; it is rather coarse.

27. Arum *esculentum.* Much cultivated by the natives who make use of the tubers in their curries, &c.

28. Arum *polyphyllum.* Very common, springing up on waste land during the rains.

29. Acalypha *Indica.*

30. Areca *Catechu.* A very graceful looking tree, extensively cultivated for the nuts (betel) which are chewed by the natives.

31. Andropogon *schoenanthus.* Sweet lemon grass, grown in flower pots.

32. A. *Ischaemum.*

33. A. *Nardus.*

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* This elegant flower (termed the *peacock flower*) forms a prominent part of the *bouquet* with which the Musselmans present Europeans on Sundays. – EDIT.

* The author states in a letter to me that "the properties of Indian plants are little known, and no dependence whatever can be placed on native names. In fact very few have any place in their nomenclature. They are *jungle ka vhool*, i.e. wild flowers." – EDIT.

† There is a fine specimen of this tree in Caranja Island. See Records, vol. i., 335. — EDIT.

34. Adiantum *lunulatum.* A fern covering old walls during the rains.

35. Avicennia *tomentosa.* Very common in salt marshes. I have seen it as large as a middle sized tree; it adorns the banks of creeks and rivers, growing in the water as well as out of it.

36. Acanthus *ilicifolius.* Sea holly. Looks pretty when in flower (dark blue colour); grows common among the Avicennia plants.

37. Artabotrys *odoratissimus.* I have only seen it in gardens; it is a pretty scandent evergreen plant, with very sweet smelling but insignificant looking flowers, as all the Annonaceae have. Decandolle calls it Unona *uncinata.*

38. Aegiceras *majus* or candel. Found common in salt marshes; it has pretty dark green leaves with white flowers.

39. Argyreia *cuneata* Sprengel. A shrub with very beautiful blue bell looking flowers. When near any support it is scandent and sends out long slender branches. Roxbugh refers it to genus Lettsomia. I have only found it on a range of hills about 24 miles west of Poona near Wurgaum. It is grown as an ornamental shrub in the gardens at Poona, but I have never met with it here.

40. Agave *America.* I have only seen it in gardens at Seroor and Aurungabad.

41. Agrostis *linearis.* A common grass.

42. Anthericum *tuberosum.* Springs up during the rains on rocky waste land.

43. Boerhaavia *diffusa.*

44. Boerhaavia *erecta.* Found about 30 miles N. E. from Poona. Stems woody, as thick as a man's finger.

45. Basella *alba* and *rubra.* Varieties cultivated as root herbs; the leaves are thick and succulent, and afford an excellent substitute for cabbage.

46. Bromelia *ananas.* Pine apple.

47. Bambusa *arundinacea.* Common and well known Bamboo.

48. Bryophyllum *calycinum.* Growing in cocoa-nut groves; rather pretty when in flower; grown in flower pots as an ornamental plant.

49. Bauhinia *speciosa.*
50. B. ,, *candida.*
51. B. ,, *variegata.*
52. B. ,, *parviflora.*
} Trees with pretty flowers, particularly the *variegata.*

53. Bergera *Konigii.* Cultivated for its leaves which the natives use in curries. The native doctors use the bark and roots as a stimulant.

54. B. *integerrima.* Found near Panwell on the main land.

55. Bassia *longifolia.* A common tree. The intoxicating spirit called mowra is distilled from the flower. Oil is also expressed from the seeds. It is a very common and useful tree. The oil obtained from the seeds is extensively used for adulterating glue.

56. Bignonia *4-locularis.* Common in the jungles, and somewhat resembling the ash. The white flowers rising from the ends of the branches look showy at a distance, but cannot bear inspection.

57. Bignonia *spathacea.*

58. Bignonia *radicans.* I have only found these two in gardens; both have pretty flowers, particularly the latter; it is a shrub of very slow growth, and was brought from China, I believe.

(*To be continued.*)

SUGAR FROM URINE.

It has long been ascertained that the urine of persons afflicted with diabetes, contained pure sugar. The following account of a loaf of sugar from such a source shows that the manufacture has increased. Indeed the sugar would, for cheapness of the *raw material,* rival that either from the best cane or Indian corn; but, unfortunately, diabetes is a disease of rare occurrence, and, with the exception of a few local instances, we are convinced that the supply from this source may be considered as absolutely nothing. "M. Peligot has presented to the Societé Philomathique, a loaf of sugar which he had extracted from the urine of a patient now in the hospital of La Charité, afflicted with the saccharine diabetes. This man voids about twenty quarts of urine a day, of which five parts in every hundred is sugar."

EXPERIMENTS ON THE HEAT OR COLD PRODUCED BY DISSOLVING SALTS IN WATER.

By Thomas Thomson, M. D., F. R. S. L. & E., &c., *Regius Professor of Chemistry in the University of Glasgow.*

1. 300 grains of crystallized carbonate of soda in powder, were thrown into 1000 grains of water of the temperature 59° in a tumbler, and the mixture was stirred till the salt was dissolved; the thermometer sunk to 43° or 16 degrees.

The water of crystallization in 300 grains of carbonate of soda is 187½ grains; which is one-seventh of 1300 grains, the whole of the liquid and salt included. Now, the water of crystallization becoming liquid would absorb 140° of heat. Hence the temperature ought to have sunk one-seventh of 140 or 20°. But the fall was only 16°; the difference is owing to the quantity of heat given out by the glass tumbler, which of course would prevent the temperature from sinking so low as it otherwise would have done.

300 grains of anhydrous carbonate of soda in powder, were thrown into 1000 grains of water of the temperature 57°·5, and stirred with a thermometer till the temperature ceased to rise. The thermometer rose from 57°·5 to 79°·5 or 22°· In another experiment from 61° to 82°·5 or 21°·5· There remained undissolved 7·7 grains of salt. The water of crystallization seems to be absorbed by this salt in the first place; hence the reason of the rise of temperature. This water amounts to 182½ grains or about one-seventh of the salt and water. Hence, the rise of temperature should be one-seventh of 140

or 20°. It exceeds this quantity a very little; the reason of which may be, that the bulb of the thermometer being at the bottom of the vessel where the salt actually dissolved, probably the temperature in that spot might have been rather higher than at the surface of the liquid.

The specific gravity of anhydrous carbonate of soda is 2·640.

The specific gravity of a saturated solution of carbonate of soda at 80° is 1·2291.

It is composed of water.......	1000
Anhydrous salt.............	292·3
	1292·3

The mean specific gravity of such a mixture is 1·1647. But the specific gravity of the solution is 1·2291. It is, therefore, a good deal denser than the means. This will explain in part the reason why the temperature is greater than it ought to be from theory.

2. 300 grains of crystallized sulphate of soda in powder, were thrown into 1000 grains of water of the temperature 57°·5, and the liquid was stirred about with a thermometer till the whole salt was dissolved. A longer time elapsed before the sulphate dissolved than was requisite for the solution of the carbonate of soda. The thermometer sunk to 45° 5 or 12°.

300 grains of anhydrous sulphate of soda in fine powder, were thrown into 1000 grains of water of the temperature 61°·5, the mixture was stirred about with a thermometer. The temperature rose to 65°·5. or 4°. This temperature continued unaltered for nearly half an hour, showing that the salt was giving out heat during the whole of that time.

The quantity of salt dissolved was 165·8 grains. The quantity remaining solid was therefore 134·2 grains.

The specific gravity of anhydrous sulphate of soda is 2·640.

The specific gravity of a saturated solution of sulphate of soda at 61°·5 is 1·1549.

Now the mean specific gravity of a mixture of 1000 grains of water of 61°·5 and 165·8 grains of anhydrous sulphate of soda is 1·0959. The solution, therefore, is a good deal denser than the mean.

3. 300 grains of crystallized sulphate of magnesia in powder were thrown into 1000 grains of water of the temperature 56° 5, and stirred with a thermometer; the solution was rapid but incomplete. The thermometer sunk from 56°·5 to 51° or 5°½.

4. 300 grains of crystallized proto-sulphate of iron in powder, were thrown into 1000 grains of water of the temperature 58°, and the mixture was stirred till the salt dissolved. The thermometer sunk from 58° to 53°·5 or 5°½. So that the cold evolved by the solution of sulphate of magnesia and proto-sulphate of iron is sensibly the same.

The quantities of water of crystallization in 300 grains of each of these salts are as follows:

	grains.
Carbonate of soda	187·50
Sulphate of soda	166 66
Sulphate of magnesia	153 65
Proto-sulphate of iron	135 96

Now, the ratios of these numbers to each other are very nearly as the numbers 37½, 33⅓, 30¾, 27$\frac{1}{5}$.

While the cold produced by the solution of each salt was 16°, 12°, 5°½, 5°½.

We see that these two ratios are not the same or even analogous to each other. It is obvious from this that the mere knowledge of the water of crystallization, and the solubility of a salt, is not sufficient to enable us to foretell the degree of cold that will be induced by its solution in water. A great deal depends upon the rapidity of the solution. Hence, it happens that more cold is produced by dissolving salts in dilute acids; because by this method the rapidity of the solution is very much increased.—*Records of Science.*

ON SOME ASTRONOMICAL METHODS OF OBSERVATION.

By William Galbraith, A. M.,
Teacher of Mathematics, Edinburgh.

ON THE OBLIQUITY OF THE ECLIPTIC.

To trace the various methods of astronomical observation used by the ancients, would be a task too laborious and irksome for our present purpose. It would not, however, be uninteresting to notice a few of their processes and instruments which they most generally employed. Among the latter the *gnomon* constructed in various ways appeared to be that in which most confidence was placed.

The rudest example of the gnomon was an upright pole, placed perpendicularly to the horizontal plane by means of a plumb line, though there are instances of some of them constructed of masonry of considerable heights, but these could not properly be called *instruments*. The altitudes of the heavenly bodies were from these calculated by comparing the length of their shadows with their heights. In modern mathematical language, the height of the gnomon divided by the length of its shadow, gives the natural tangent of the altitude of the celestial body, such as the sun, whence by means of a table of natural tangents the angular measure of that altitude becomes known in some conventional measure, such as degrees. Thus let the height of the gnomon be 5 feet, and the length of its shadow 10 feet, then $\frac{5}{10}$ or 0·5 being found in a table of natural tangents will give the angle equal to about 26° 30′, the altitude of the sun at that time.

This method was found to be inconvenient, because the length of the shadow was required to be measured each time an observation was made. It, therefore, occurred to the ancient astronomers to form an instrument of moderate dimensions on similar principles, like the artizan's square, having the horizontal side divided into equal parts as it was at first, and afterwards into the natural tangents called by the Arabians *shadows*, to the radius, and by this means the angle of elevation became known in degrees and parts of a degree by inspection, though not to any great accuracy.

This gave place in its turn to the quadrant, divided into degrees and parts of a degree by means of a radius turning round its centre, in which were placed fine pins or sight vanes. It was with such instruments as these that Eratosthenes and Ptolemy attempted the measurement of the figure and magnitude of the earth, and the determination of the obliquity of the ecliptic. Ptolemy states that the distance between the tropics in his time was found by such an instrument to be $\frac{11}{83}$ of the whole circumference, that is $\frac{11}{83}$ of $360^\circ = 47^\circ 42' 40''$, and the half of this or $23^\circ 51' 20''$ constitutes what is called the obliquity of the ecliptic.

The accuracy of observations made with the quadrant could not be great till the invention of the telescope and the vernier or reading microscope. The quadrant, though a good instrument with these appendages, and was long so used, has, at last, given place almost universally to the circle which by means of verniers reading round the whole circumference destroy by mechanical means, probably, the small incidental errors inseparable from materials and workmanship, however excellent both may be. "With all the care that could be employed, errors to the amount of 20″ or 30″ were known to exist in the observations of some of the continental observatories, and even to the amount of from 5″ to 10″ in those of Greenwich." Indeed, Troughton has been heard to affirm that a well divided circle of a single foot in diameter is more to be depended upon than a fixed quadrant of the largest construction. In a series of four observations made with the six inch circles of Kater as constructed by Robinson, I have never found, under favourable circumstances, the errors to exceed ten or fifteen seconds. Now, in the preface to the first volume of the Greenwich observations, published by Maskelyne in 1776, he makes the following remarks: "The sun and moon and some of the principal fixed stars are constantly observed on the meridian every day when the weather will permit; and the exactness of the instruments is so great, and their rectifications so nice, that the place of any heavenly body may always be found by them within ten seconds of a degree both in longitude and latitude, and generally much nearer." He then possessed a great mural quadrant of eight feet radius, by Bird, and we, therefore, see that our small circles of few inches in diameter are nearly as accurate as the old quadrants of as many feet, and they approach much nearer to perfection than we had any reason to anticipate. Such small portable circles are consequently very valuable to the amateur astronomer, as well as the scientific traveller, since, in the hands of a skilful observer, they furnish results highly useful for the improvement of geography, astronomy, and navigation, while at the same time their moderate price enables many to become purchasers.

In a letter from Captain Kater of the 25th of February, 1831, he remarks: "the size I recommend, and which I use is only 3 inches in diameter, and in the latest construction has only a vertical circle which can, however, be placed in the plane of any two objects so as to take the angle between them, the whole contained in a box 7 inches long, $4\frac{1}{2}$ inches wide, and 3 deep, so that it really deserves the name I originally gave, that of a pocket azimuth and altitude circle. With this little circle I can get, in one evening, my latitude to within 5″ of the truth by the pole star." Such are literally the expressions of the late Captain Kater, the inventor of this instrument, and the advantages of it to scientific travellers are very obvious.

(*To be continued.*)

ON A VERY POWERFUL NATURAL MAGNET.

By Mr. J. Crichton, Glasgow.

To the Editor of the Records of General Science.

Sir,—The extremely small loadstone which belonged to my deceased father, and of which you desire to receive some details, is perhaps the most powerful of its kind ever known. By the scientific reader it will probably be regarded as a very curious and rare production of nature, while by some others it may be thought to possess interest of a different description. Since no other person, now alive, knows any thing of its history, I shall, from my own immediate knowledge and circumstantial recollection, give the best account of its origin, which at this time it is possible to put on record.

In 1772, or the succeeding year, when Benjamin Franklin was in Glasgow, he called on the late Professor Anderson. Much of the conversation which took place between them was on electricity; both were enthusiasts in this branch of science. And, at their joint representation, the thunder-rod, still on the College steeple here, was erected with a view to its protection from the effects of lightning.

Magnetism also became the subject of discussion, in the course of which, the Professor desired my father, who at that time lived in the Professor's house as his mechanist, to exhibit some artificial magnets he had just finished. On this occasion Franklin mentioned, on the authority of his friend Washington, that some place in Virginia afforded very fine loadstones, and added, that on his return to America, he would endeavour to procure a specimen and send it to the Professor.

This was not neglected, for, in 1776, the Professor received the promised mineral, which was probably brought to France by Dr. Franklin, whence he transmitted it to Glasgow as a present from Washington himself. The most promising portion of the mass was selected, and my father, then working on his own account, was employed to arm it in the most approved manner; but, though this was carefully performed, its power was in no way remarkable. Several smaller portions of the

mass were similarly fitted up; these, however, like the principal one, proving almost valueless, the Professor declined making further trials, and finally laid aside all thoughts of the matter.

Some years afterwards, I think in 1781, my father, casually rummaging a lumber-box which stood under his work-bench, perceived some small fragments of the almost forgotten loadstone surrounded by iron filings and other ferruginous dust, and remarking that one of these fragments carried a larger *beard* of filings than the others, he was thereby induced, at his first leisure, to bestow, what he then thought, a little hopeless labour in grinding it to a proper shape with due regard to its poles. The diminutive iron arms were attached in a temporary manner by means of a thread, when, to his great surprise, its first load, though hastily applied and supposed to be in excess, required sensible force for its removal.

It now seemed worthy of some additional labour; the form in regard to polarity was re-examined, and when finished in this respect, the stone, after being weighed, was with its arming enclosed in a thin case of gold, having a ring at top for suspending it. Its load, a pyramidal shaped piece of soft iron, was now made of what was judged a weight rather under its maximum power, that is, 783 grains; the stone itself weighs precisely two and a half grains; it carries, therefore, 313 times its own weight.

It is now about 55 years since this little spark of the mine was first enclosed; upwards of 30 years ago the case was opened, in order to apply arms of perhaps a better shape; the old ones, however, appearing in all respects faultless, the whole was immediately put together in its original state.

Scientific individuals have frequently suggested the propriety of keeping it with the load constantly attached, as a mean, they allege, of increasing its strength. This, I apprehend, is rather a gratuitous assumption; besides, constant adhesion could not be maintained owing to the tremors incessantly taking place in every dwelling house. Though it is not doubted, that, by careful application, the load could be increased to considerably more than 800 grains; still, as there is reason for thinking that violent separation of the load, under such circumstances, might prove injurious, the trial has never been made.

The same mass of iron has been used as its load from the beginning, and is placed merely in contact with the arms. The power of adhesion seems to be the same as it has ever been.

JAMES CRICHTON.

Glasgow, 1st March, 1836.

PHENOMENA OF CRYSTALLIZATION.

When the formation of crystals are observed under the microscope according to Ehrenberg, the first thing which attracts attention is a rapid action going on about the crystal; suddenly a solid point forms in the transparent liquid, appreciable by its opalescence, and increases with astonishing rapidity, shewing that this point concentrates and condenses the saline particles previously dispersed and suspended in the water. This concentration supposes a motion towards the centre, and one is apt to think that the aggregation of the atoms is of such a nature that the density will increase towards the edge. In this view it is rather surprising that there should be no motion nor agitation in the neighbourhood of the crystal. In order to investigate the subject more accurately, Ehrenberg examined strongly coloured crystals. He dissolved bichromate of potash and sulphate of copper in water: he could not discover in either case any visible current resulting from the concentration of the coloured particles, nor an aggregation around the crystal, while it increased with great rapidity; yet even by sprinkling a fine powder over the liquid which crystallized, no currents could be detected. Hence, crystallization is analogous to the phenomena which, it is generally supposed, take place when masses aggregate in space. A nebulous appearance first occurs, the matter of which gradually condenses in the centre, then a kernel is formed with an areola, and lastly a properly formed world is completed.

Ehrenberg has carefully studied some drops of a solution of common salt, and has observed that hexagonal tables are formed at the limit of evaporation often very regular but frequently deposited one upon the other. In the middle of these very delicate hexagonal tables a point was suddenly formed which attracted to it the mass of tables. Immediately the observer noticed there a small tube increasing with immense rapidity and enlarging as the tables diminished. The waters of the Baltic and N. Sea are particularly fitted for these observations. Conceiving that the phenomena might be owing to the presence of two different salts, he made an experiment upon common salt, chemically pure and dissolved in distilled water. In this case he observed the same, only not so frequently; the cubes being generally formed immediately. Mitscherlich has shown that common salt forms hexagonal plates at very low temperatures. But in the present case the temperature was that of the atmosphere. Did the cold produced by the evaporation influence it?—*Poggendorff's Ann.* No. x., 1835.

PRESERVATION OF ANIMAL SUBSTANCES BY CARBONIZATION.

[A short notice of this new discovery appeared in our 667th Number. The following

additional particulars are from the *American Journal of Science and Arts*.—Ed. M.M.]

The following are some of the objects that have been subjected to the petrifying process. One of Sig. Segato's first experiments was performed upon a Canary bird. It is still preserved unaltered, although it is now ten years since the experiment was performed; and it has been submitted to the action of water and of insects. A parrot retains its original brilliancy of plumage, unimpaired. Eggs of the land turtle, turtles, various tarantulæ, a water-snake, a toad, various kinds of fish, snails and insects, are in a perfect state of preservation. To these are added various parts of the human body. A hand of a lady, who died of consumption, preserves the emaciation of the disease and of death. Another of a man is flexible in the different phalangic articulations, and yet unalterable: a foot with the nails perfectly fast; a collection of all the intestines of a child, in their natural colours and forms, with the fecal matters unremoved; the liver of a man who died from intemperance, dark and lustrous like ebony; an entire human brain with its convolutions, of extreme hardness; the skin of a woman's breast naturally configured; a pate of a girl pefectly flexible, from which the hair hangs in curls; the head of an infant partly destroyed, and discoloured by putrefaction. There is also in the cabinet of Sig. Segato a table constructed as follows. A spheroidal surface of wood contains a parallelogram, composed of two hundred and fourteen pieces, regularly arranged. These to the eye appear like the most beautiful pietre dure that have been produced by nature. Their various colours, polish, and splendour, and their surprising hardness, would leave no doubt of their stony character. The sharpest file, with difficulty, makes an impression on any of them; some it does not attack at all. These pieces are all portions of the human body, hardened by this new process; as the heart, liver, pancreas, spleen, tongue, brain, arteries, &c. &c., all resembling the most highly-polished precious marbles. An entire body has not yet been tried, principally on account of the limited resources of Sig. Segato, although the expense would be but about one-tenth of that of embalming by the ordinary process.

Great advantages to science, especially to natural history and human anatomy, are expected to result from this discovery; and it is even confidently believed that the remains of friends, of men of science and of worth, may be preserved for ages in the exact form and appearance, in which the hand of death found them, with nothing offensive or revolting about them.

As vouchers for the accuracy of the statements contained in the pamphlet, the certificates of many of the distinguished physicians, professors, and men of science in Florence, where Sig. Segato resides, are appended. Among them, it is sufficient to mention the names of Sig. Betti, Professor of Physiology; Sig. Zannetti, Professor of Human Anatomy; and Dr. Gazzeri, Professor of Chemistry.

MAGNETIC CHARACTERS OF THE METALS.

The opinion of Dr. Faraday, as stated at the Royal Institution in reference to the metals, is, that they are all magnetic, just as they are all capable of being solidified, but that a proper temperature is the desideratum, as with mercury, for the solidification of which a low temperature is required. The analogy is principally derived from the case of iron which loses its magnetic power at an orange heat, and when cooled down regains its attractive power. Nickel exhibits similar properties. When heated and cooled, it retains its negative state long after it has ceased to be visible in the dark. Even when immersed in hot almond oil it loses its magnetic power. This point appears to be between 630° and 640°. Cobalt and chromium are stated in chemical works to be magnetic. Dr. Faraday found that specimens of these metals, which were said to be magnetic, derived that property from the presence of iron or nickel. The result of his experience in respect to chromium is similar to that of Dr. Thomson, who long ago determined that it was not magnetic. Dr. Faraday endeavoured to excite the magnetic power in a number of metals by sinking their temperatures to 60° and 70°, but could not succeed; nevertheless, he is convinced that the only desideratum, in reference to the development of magnetism in all metals, is the particular magnetic temperature.

NOTICE OF SOME RECENT IMPROVEMENTS IN SCIENCE.

CHEMISTRY.

I. SOLIDIFICATION OF CARBONIC ACID.—Thilorier has succeeded in reducing this gas to a solid state, by exposing it to a temperature of 148° F. (?) Even when exposed to the air, it remains in this state for a short time. Its elastic force appears to be deteriorated by being solidified, as in this state it gradually dissipates. It may be also rendered solid by suddenly raising it from a liquid to a gaseous state. When a stream of the acid is directed into a small glass phial, the latter is filled with a white powder. If a small portion of the solid acid is placed in a stoppered vessel, it soon fills the flask with a thick vapour, and the stopper is forcibly expelled.—*Gazette Medicale, Oct.*, 1835.

II. NAPHTHALINE AND ITS COMPOUNDS.—*Naphthaline* was procured by Laurent, by boiling coal-tar in the open air until it was deprived of its water, and then distilling it in a retort with a copper beak and

a glass receiver. The first product is a yellow substance which turns black in the air, and deposits much naphthaline. The second contains more naphthaline; the third is viscid, orange-coloured, and contains much paranaphthaline. The last contains a substance with the colour of realgar, which has not been examined. The first oils produce the naphthaline. These are distilled and purified by crystallization by means of alcohol. The specific gravity of its vapour is 4·528 by experiment.

Hence, we may consider its composition,

10 atoms Carbon, ..	4·166 =	·75	10 atoms	
5 ,, Hydrogen, ..	·347 =	·625	5,,	
	4·511	8 125		

It is, therefore, a bi-penta-carbydrogen or C10 H5.

1. CHLORIDE OF NAPHTHALINE* of Laurent is obtained by combining chlorine with naphthaline without heat. It is a white powder, but may be obtained in rhomboidal plates by solution in ether. Smell strong. Melts at 284°. When distilled, it is decomposed, but it may be volatilized in an open tube. Insoluble in water; little soluble in alcohol; more soluble in ether. Boiling sulphuric and nitric acids decompose it. Potash takes up muriatic acid from it. Potassium destroys it. It consists of carbon 45, hydrogen 2.9, chlorine 52·1.

2. CHLORO-NAPHTHALASE.—When chlorine begins to act upon naphthaline, an oil is formed which it is difficult to separate from the preceding chloride and naphthaline. By dissolving it in ether, and allowing it to stand for some hours, the latter separates. Lastly, by dissolving it in alcohol and allowing it to settle, we observe that the solid chloride precipitates first, then the oily chloride, and last of all, the naphthaline. In this way it may be isolated. It contains carbon 60·9, hydrogen 3 9, chlorine 35·2.

3. CHLORO-NAPHTHALESE.—When naphthaline is treated with chlorine; after being liquified, the matter becomes solid. A product is obtained which affords chloro-naphthalese by the simple action of potash. The product is placed in a retort along with a strong solution of potash in alcohol. Heat is applied and the alcohol collected. Pour a little water on the residue, the excess of potash and some chloride of potassium will be separated. An oil is deposited which is treated again with alcohol and potash. It is then precipitated by water. In a few hours it becomes a pearly mass crystallizing by sublimation. This is chloro-naphthalese. It consists of carbon, 61·4, hydrogen 3·, chlorine 35·6.

4. PERCHLORO-NAPHTHALESE.—If, instead of treating the preceding body with potash, we distil it, it is partly decomposed, and a portion passes over with an oil. By expressing the product between paper we obtain a pure substance which crystallizes by means of alcohol in needles with a rhomboidal base. It is isomorphous with the preceding.

If this pyrogenous compound is treated with a current of dry chlorine at the usual temperature, the gas combines with it and forms a solid, which, when dissolved in ether, crystallizes in small prisms. It is colourless, insoluble in water, little soluble in alcohol, more so in ether. It may be distilled. It consists of carbon 25·4, hydrogen 1·2, chlorine 73·4.

5. CHLORO-NAPHTHALOSE. When naphthaline is submitted to the action of chlorine it liquifies, and muriatic gas is evolved. The matter becomes solid. By applying heat and continuing the action, a crystalline mass is obtained, which may be purified by dissolving it several times in alcohol or ether. The crystals are oblique prisms. Chloro-naphthalose is white and insipid. It distils without change. Burns with a green flame. At a red heat, lime converts it into chloride of calcium and carbon. It consists of carbon 45·6, hydrogen 1·5, chlorine 52·9.

6. HYDRO-CHLORATE OF CHLORO-NAPHTHALASE.—This compound is produced by first passing a current of chlorine over naphthaline; this process should be stopped when the only product, which was heated during the re-action, begins to deposit a white matter. This oil is a mixture of naphthaline, oily chloride, and solid chloride. When exposed to a temperature between 122° and 140° in a small capsule, then dissolved in ether and exposed to a cold of 14°, the greater part of the solid chloride is deposited. The ethereal solution when mixed with alcohol and exposed to the air deposits $\frac{4}{5}$ths of oil. The remainder, when exposed to a heat sufficient to expel the ether and alcohol, is pure hydrochlorate of chloro-naphthalase. It is only, slightly yellow, soluble in alcohol and ether. Chlorine converts it into hydro-chlorate of chloro-naphthalese. It is decomposed by potassium, and partially by distillation. Its constituents are carbon 61·435, hydrogen 3·525, chlorine 35·040.

7. HYDRO-CHLORATE OF CHLORO-NAPHTHALESE or solid chloride is obtained by the process just described. After the action of the chlorine has ceased, it is necessary to take up the oily matter with the ether, and to dissolve the residue in this liquid with heat in a closed flask, and to crystallize by cooling. Boiling sulphuric acid converts it, 1st, into a matter insoluble in water, and soluble in ether. When this solution is evaporated a transparent varnish is left. 2d. Another substance which remains in solution and gives, with barytes, an incrystallizable

* Laurent employs a new nomenclature to designate this numerous class of compounds. It consists in changing the vowel of the final syllable of the name of the substance in proportion as the hydrogen is replaced by combining bodies. Chloro-naphthalase will contain 2 atoms of hydrogen less than naphthaline, and will have gained 2 atoms of chlorine. Chloro-naphthalese will contain 4 atoms of hydrogen less than naphthaline, and will have gained 2 atoms of chlorine. Chloro-naphthalise is not known. Chloro-naphthalose contains 8 atoms of hydrogen less than naphthaline.

salt soluble in alcohol, which is probably a sulpho-salt analogous to the sulpho-naphthalates. Hydro-chlorate of chloro-naphthalese consists of carbon 44·79, hydrogen 2·70 chlorine 52·51.

8. BROMO-NAPHTHALASE.—When a few drops of bromine are poured upon naphthaline a lively action ensues, heat and hydrobromic acid are disengaged, and an oily product is formed. This consists of carbon 50 9. hydrogen 2 9, bromine 46·2. This oil is evidently a mixture of two substances, the first of which has not been separated, but the second.

9. BROMO-NAPHTHALESE may be obtained by distilling a mixture of bromine and naphthaline. Hydrobromic acid, a bromine oil, and charcoal come over, and towards the end of the process crystals of bromo-naphthalese appear. These are formed most completely when the bromine has been added in excess to the naphthaline. In dissolving this product in alcohol and evaporating, we obtain six-sided prismatic needles. They are white, insoluble in water, volatile, very soluble in alcohol and ether. They consist of carbon 42·9, hydrogen 2·1, bromine 55.

10. BROMIDE OF CHLORO-NAPHTHALESE is formed by pouring bromine upon chloro-naphthalese in a close flask. The latter dissolves and solidifies into a crystalline mass. When purified by alcohol it resembles the chloride of chloro-naphthalese, and consists of carbon 23·5, hydrogen 1·05, chlorine and bromine 74·45.

11. NITRO-NAPHTHALASE is formed by the action of boiling nitric acid upon naphthaline. A new oil is obtained first, which solidifies very slowly by cooling, forming a crystalline mass of large needles. It consists of two bodies very soluble in alcohol and ether, the one is solid or nitro-naphthalase, the other is liquid. The former is expressed between folds of paper. It is then dissolved in alcohol. On cooling, drops subside to the bottom of the vessel, containing much nitro-naphthalase, which is separated by solution in alcohol. The alcohol lets fall crystals. They are four-sided prisms terminated by acute pyramids. Colour sulphur-yellow. Volatile. Insoluble in water; very soluble in alcohol and ether. Analysis gave carbon 69 86, hydrogen 4 07, azote 8 53, oxygen 17·54.

(To be continued.)

THE TRANSACTIONS OF THE LINNEAN SOCIETY OF LONDON.

Vol. XVII, part 3rd, 1836.

The number of communications in this portion of the transactions amounts to 12, most of which are important.

BOTANY.

REMARKS ON SOME BRITISH FERNS.

By Mr. David Don, Lib. L. S.

The object of this paper is to determine how far some species of ferns recently added to the British Flora, merit the rank which has been assigned to them.

Aspidium dumetorum, of Smith he has ascertained to be merely a diseased state of A. *dilatatum*, which is shown by the sudden termination of the costae, and by the partial decay of the other segments.

Nephrodium rigidum turns out to be the same with the plant of Swartz. It differs from N. *dilatatum* and N. *spinulosum*, in having larger and more crowded sori, and a broader and more depressed indusium. The fronds are lanceolate and both the stipes and rachis are copiously clothed with long narrow ramentaceous scales, as in *aspidium aculeatum*. In *dilatatum* and *spinulosum* the rachis is nearly naked, and the stipes is furnished with fewer and broader scales. From N. *felix mas* it is distinguished by its more delicate fronds, having the *pinulae* pinnatified and a more scaly rachis.

Asplenium filix foemina is observed in the shape of two different varieties, but neither of them are entitled to be regarded as a distinct form.

Cystea dentata or *Polypodium dentatum* of Dickson, who first distinguished it from *fragilis*, inhabits Clova, and appears peculiar to the Scottish Alps.

Cystea regia. Contrary to the opinion of Hooker, Mr. Don considers this plant distinct from *alpina*,being characterised by its more compact frond, by its shorter, broader and cuneiform segments, by the still more important characters of its more copious sori, and of its narrower and tapering indusium. In the *Alpina* the segments are linear and the sori much fewer, being mostly solitary on the lobes, and the indusium broader, truncate, and not taper pointed. No British station now exists for this plant.

DESCRIPTION OF FIVE NEW SPECIES OF THE GENUS PINUS, DISCOVERED BY DR. COULTER IN CALIFORNIA.

By Mr. David Don, Lib. L. S.

Notwithstanding the addition of seven new species to this genus, by Mr. Douglas, within the space of a very few years, we have in this paper a detail of the character of five additional species discovered by Dr. Coulter, in California; especially on the western flanks of the northern Andes, and the extensive parallel ranges of mountains which extend from south to north through that country.

1. THE P. COULTERI rises to the height of 80 or 100 feet at an elevation of from 3000 to 4000 feet above the level of the sea; growing intermingled with the *P. Lambertiana* on the mountains of St. Lucia, near the Mission of San Antonio, in latitude

36°. 2. *P. muricata* attains a height of 40 feet. It was found at San Luis Obispo in latitude 35°, at an elevation of 3000 feet. 3. *P. radiata* found about Monterey in latitude 36°, near the level of the sea, and growing almost close to the beach. It affords excellent timber, which is very tough and admirably adapted for building boats. 4. *P. tuberculata*, resembling in position and appearance the preceding. 5. *P. bracteata* was found growing on the sea side of the mountain range of St. Lucia, about 1000 feet lower than P. Coulteri. The trunk rises to the height of 120 feet, not exceeding 2 feet in circumference and as straight as an arrow.

SOME ACCOUNT OF THE GALLS FOUND ON A SPECIES OF OAK, FROM THE SHORES OF THE DEAD SEA.

By Aylmer Bourke Lambert, Esq., F. R. S., V. P. L. S.

This paper contains a description with figures of some galls brought from the Holy Land by the Hon. R. Curzen, and which the author considers to be the "mala insana," or apples of Sodom of history. They grow on the *Q vercus infectoria*, a tree which grows abundantly in Syria. The insect which forms them has been named by Olivier *Diplolepis*. When on the tree the galls are of a rich purple, and are varnished over with a light substance of the consistence of honey, shining with a most brilliant lustre in the sun, which makes them look like a most delicious and tempting fruit.

NOTE ON THE MUSTARD PLANT OF THE SCRIPTURE.

By Mr. Lambert.

The author considers this plant to be the same as that daily used among us. He conceives that the expression "less than all the seeds that be in the earth," used in Scripture was used comparatively and meant nothing more than a small seed. Captains Irby and Mangles have informed the author that our mustard plant, the *sinapis nigra*, grows in the Holy Land as high as their horses heads, and other travellers have seen it growing to the height of 10 feet.

ON SEVERAL NEW OR IMPERFECTLY UNDERSTOOD BRITISH AND EUROPEAN PLANTS.

By C. C. Babington, F. L. S., &c.

1. HERNIARIA HIRSUTA, has been found only at Colney Hatch Barnet, by Hudson, and Milne, and Gordon, but not since 1793.

2. H. GLABRA.—Near Newmarket, Rev. Mr. Hemsted. The description under this title in Hooker's Flora applies to *H. ciliata*.

3. H. CILIATA.—Lizard point, Ray and Borrer.

4. CREPIS VIRENS.—Common on walls, &c. This plant has usually been confounded with *C. tectorum*, which does not appear to be a native of this country. It is distinguished from *virens* by its "very long fruit, equalling the pappus: attenuated above, its ribs rough; the margin also of the upper leaves is revolute, that not being the case in *C. virens*."

5. C. BIENNIS.—Involucrum, ovate, oblong, both when in flower and seed, not becoming ventricose as in *C. virens*.

6. ERICA TETRALIX. Stems branched only towards the base. Leaves and sepals linear, lanceolate, downy, their margins secured so as almost to meet behind.

7. E. MACKAIANA, N. S.—Fol quatern. ovat. ciliat. supra glabris, floribus capitat. pedicellatis, sepalis ovat. ciliat. glabris, pedicellis pilos. et comentosis, corolla oblong. ovatis, antheris anstat. inclusis, stylo exserto.—Distinguished from *E. Tetralix* by the form and structure of its leaves and sepals, the glabrous upper surface of the former, and its total difference in habit. It agrees with *E. ciliaris* in the character of its foliage, but differs from that plant by having anthers awned. Gathered by the author on Craigha Moira, Connamara, Ireland, in August, 1835. Mr. McCalla, of Roundstone, directed his attention to it, as being, perhaps, a new British heath. It is named after Mr. Mackay, of Dublin. Some botanists consider it as a variety of E. Tetralix.

8. POLYGONUM MARITIMUM.—Christchurchhead, towards Muddiford *Borrer*; Herne Bay, Jersey. Mr. W. C. Trevelyan.

9. P. RAII.—Intermediate between *P. Maritimum* and *aviculare*. The *P. aviculare* β of Hook. Brit. Flora.

10. P. DUMETORUM—Wood at Wimbledon: Mr. J. A. Hankey.

11. P. CONVOLVULUS.—Improved description by the author.

12. EUPHORBIA PILOSA.—E. pilosa β of Hooker.

13. EUPHORBIA CORALLOXIDES—E pilosa *a* of Hooker: naturalized at Henfold, Sussex.

14. HABENARIA CHLORANTHA—*Orchis* bifolia *a* of Smith.

15. H. BIFOLIA.—O. bifolia β of Smith.

16. H. FORNICATA—A distinct species, having its anther rounded at the tip and hooded, and the cells parallel; plant smaller than *H. bifolia*.

OBSERVATIONS ON THE SPECIES OF FEDIA.

By Joseph Woods, Esq., F. L. S.

This genus was originally made from the varieties of the Linnean species, *Valeriana locusta*, being separated from Valeriana by habit as well as by the want of a feathery crown to the seed. The name comes from Hœdus, or Fœdus, a kid, and was introduced

by Adanson, although not applied by him to this genus. Decandolle divides it into four divisions. 1. *Locusta:* with one or two empty cells and a gibbous corky or spongy mass at the back of the fertile one. 2. *Psilocoelae:* the two empty cells, each reduced to a hollow nerve. 3. *Platycoelae:* two empty cells, near y as large as the fertile ones. 4. *Selenocoelae:* section of the fruit, crescent shaped, with two empty cells.

Mr. Woods suggests that the European species may be divided as follows: A. Flowers ringent. 1. *F. Cornucopiæ:* B. flowers nearly regular: *A.* fruit with a corky mass at the back of the seed. 2. *F. olitoria.* 3. *F. gibbosa b.* section of the fruit crescent shaped, two barren cells. *a. F. turgida.* 5. *F. carinata.* 6. *F. platyloba: C.* barren cells two, hardly touching in the middle; divisions of the calyxhooked; flowers in globular heads; upper leaves generally pinnatified at the base. 7. *F. Hamata.* 8. *F. Coronata.* 9. *F. Ciliata: d* barren cells two, hardly touching in the middle; prolonged in to teeth or horns, but not forming a membranous calyx. 10. *F. echinata.* 11. *F. trigonocarpa.* 12. *F. Sphaerocarpa.* 13. *F. pumila: e* barren cells two contiguous; crown erect. 14. *F. auricula: f* barren cells four 15. *F. vesicaria: g* barren cells wanting, or reduced to a mere nerve; panicle nearly fastigiate: the lower flowers solitary. 16. *F. lasiocephala.* 17. *F. eriocarpa.* 18. *F. dentata* 19. *F. puberula.* 20. *F. microcarpa.* 21. *F. truncata.* The paper is illustrated by drawings.

DE MERCHANTIEIS AUCTORE THOMA, &c. TAYLOR, M. D., F. L. S.

The species of this order of plants, although limited in number, are widely spread over the world, as we find from the Baltic sea to the Mediterranean in Europe, over all America and even the mountains of Nepaul. The author treats of such in this paper as have come under his notice, under the genera *Marchantia, Fegatella, Fimbraria, Lunularia, Hygropyla.* Those who are fond of the study of this beautiful order of plants, we cannot direct to a more distinct source for the solution of any difficulties which they may happen to meet with, although it would have more congenial to the acquirements of most botanists if the concluding remarks on each species had been couched in English instead of Latin. We approve of the use of the latter language for stating the specific characters, but to carry the use of a dead language any further is an abuse.

ON THE ERIOGONEAE, A TRIBE OF THE ORDER POLYGONACEAE.

By G. Bentham, Esq., F. L S.

The genus *Eriogonum* was first established by Michaux in his *Flora Boreali-Americana.* The number of plants now known which approach nearly to this genus amount to 40 species. In this paper Mr. Bentham proposes to divide these into three genera. All the species are equally distinguished by their involucrate inflorescence and absence of stipulae, at least to the lower or cauline leaves. But a considerable difference of habit has induced him, at the suggestion of Mr. Brown, not only to separate generically 5 species with uniflorous involucres; but among these to isolate one (*Mucronea*) which has a compressed and bidentate involucre formed of two leaves instead of a triangular sexdentate one formed of six leaves as in the four species (*Chorizanthe*). The latter genus is further confirmed and augmented by seven species collected in Chili by Macrae, Cuming, Bridges, &c.

OBSERVATIONS ON THE GENUS HOSACKIA AND THE AMERICAN LOTI.

By George Bentham, Esq., F.L.S.

The author modifying his views expressed in the Botanical Register (vol. xv. tab. 1257,) in reference to these two genera, is now induced to confine the circumscription of Hosackia to the umbellate species, and proposes to consider the uniflorous ones as belonging to *Lotus* of which they would form a separate section, which, with reference to the size of the flowers, might be called *Microlotus.* The two genera would then be characterized by the form of the flower; and the peculiarities observable in the organs of vegetation would again be reduced to their proper level, that of subsidiary, not essential characters. In the true *Hosackiae* the claw of the vexillum is always at some distance from those of the other petals; the alae adhere by their margins to the carina, and usually (if not always) spread at right angles from it; the carina is usually less rostrate than in Lotus and the stigma more distinctly capitate. In Microlotus the flower does not present any essential differences from that of our European *Loti.* The author describes 11 species of *Hosackia,* and 5 species of *Microlotus.*

ENTOMOLOGY.

Descriptions, &c., of the Insects collected by Captain P. P. King, R. N., F. R. S. in the Survey of the Straits of Magellan. By John Curtis, Esq., F. L. S.; A. H. Haliday, Esq., M. A., and Francis Walker, Esq., F. L. S.

The collection was formed along the coast from St. Paul's in Brazil to Valparaiso. It is interesting to trace the similarity which exists between the corresponding parallels of the southern and northern hemispheres such as is afforded by the present collection. Thus the genus Carabus appears unknown in S. America, excepting about lat. 50° where a species of that group with a narrow thorax has been found; the genus *culex* also occurs. The insects of S. America bear little resemblance to those of S. Africa. Descriptions are given of species belonging to 55 genera of *Hymenoptera,* and of 78 genera of *Diptera.* —*Records of Science.*

CHARACTERS OF EMBIA, A GENUS OF INSECTS ALLIED TO THE WHITE ANTS (TERMITES), WITH DESCRIPTIONS OF THE SPECIES OF WHICH IT IS COMPOSED.

BY J. O. WESTWOOD, Esq., F. L. S.

This genus is remarkable at present not only because it consists of species nearly allied to the white ants, but because it is composed of 3 exotic species, each from a different quarter of the globe, while a single specimen only of each has hitherto come under the observation of entomologists; each possesses also characters of a higher rank than mere specific distinction, whence he has been under the necessity of considering each as a distinct subgenus; these are Embia Savignii, Oligotoma Saundersii, and Olynthia Braziliensis. Mr. Westwood has also observed two species imbedded in Gum Copal or Anime, which he has not been able sufficiently to identify.

ON A NEW ARACHNIDE UNITING THE GENERA GONYLEPTES AND PHALANGIUM.

BY THE REV. F. W. HOPE, M. A., F. R. S., F. L. S.

This remarkable insect with disproportionally long hinder legs, so long that it is difficult to conceive of what utility they can be, was collected in Brazil by the late Mr. Haworth, a zealous promoter of entomology in all its branches. Mr. Hope terms it *Dolichoscelis Haworthii.*

ZOOLOGY.

DESCRIPTION OF A NEW SPECIES OF THE GENUS CHAMELEON.

BY MR. SAMUEL STUTCHBURG, A. L. S., &c.

CHAMELEON CRISTATUS. C. Superciliari occipitalique carina elevatâ et crenulatâ, caudæ anteriori parte dorsique apophysibus elongatis cristam dorsalem constituentibus: squamis fere rotundis subæqualibus. The striking peculiarity of this animal consists in its having a dorsal crest, supported by the spinous processes of the vertebræ, by which character it approaches the basilisks. It was brought from the banks of the river Gaboon in Western Equinoctial Africa, and was presented to the Museum of the Bristol Institution, by Messrs. King and Sons of that city.

THE PRACTICAL MECHANIC'S POCKET GUIDE, &c.

BY ROBERT WALLACE, A. M., GLASGOW, 1836. p. 120.

This is a very neat and useful little compendium of the most important rules for the practical mechanic, arranged under the heads of I. Prime movers of machinery; 1st. Animal power.—2d. Wind power.—3rd. Water power.—4th. Steam power. II. Weight, strength, and strain of materials. III. Practical tables: 1st. Weight of metals.—2nd. Specific gravity and weight of materials.—3rd. Steam and steam engines.—4th. Specific cohesion and strength of materials.—5th. Mechanical powers. The section upon steam is illustrated by a good plate of the steam engine, and a plan is appended to the work of the land which has been drained behind the town of Greenock, and of the great reservoir which is supplied by these numerous drains. We have no doubt that Mr. Wallace's book will be duly appreciated by those for whom it is intended, and we recommend it to the attention not of mechanics alone, but of all who are interested in this important branch of philosophy.

THE INDIA REVIEW.

Calcutta: December 15, 1836.

LORD AUCKLAND'S SCIENTIFIC PARTY.

Dr. O'Shaughnessy demonstrated by experiments the nature and properties of oxygen and hydrogen gases, and the composition of water, by introducing them in a close glass vessel, the inside of which, though clean and dry before the experiment, became dewy. This was done with Cavendish's apparatus, by exploding the mixture with an electrical spark. Dr. O'Shaughnessy took that opportunity of bringing to the notice of his hearers that, within a week past, he had received information of a new experiment, by which it was shown that hydrogen gas was a complete test for arsenic, which Dr. O'Shaughnessy considered an invaluable discovery.

He placed a few drops of Fowler's solution in a vessel with water, and obtained hydrogen by solution of zinc in sulphuric acid. The hydrogen being ignited was allowed to play in a small jet in a glass tube; where Dr. O'Shaughnessy supposed it deposited the arsenic.

Fresh lime water, added to a fluid containing arsenic, is said to have precipitated 1-30th of a grain of the metal. But Dr. O'Shaughnessy thought that hydrogen gas would detect the 500th part of a grain. We suppose this experiment has originated from the well known test of water saturated with sulphurretted hydrogen gas, formed by the action of diluted muriatic acid on sulphu-

retted iron, which has been considered a delicate test, producing an orange-yellow precipitate or the hydro-sulphuret of arsenic. We prefer this to the experiment brought forward on this occasion, because zinc sometimes contains arsenic. Dilute sulphuric acid dissolves zinc: at the same time that the temperature of the solvent is increased, and much hydrogen escapes, an undissolved residue is left which, Proust says, is a mixture of arsenic, lead, and copper.

But Dr. Christison has maintained that the liquid tests have been found liable to many fallacies, and their details have seldom carried conviction to the Judge or Jury; it was therefore desirable in his opinion to obtain evidence from reduction and sublimation. He endeavoured to show that the fourth part of a grain might be presented in its metallic form, although it had been dissolved in eight thousand parts of the most complicated vegetable and animal fluids. The experiments that he performed led to the conclusion, that the proof of the existence of arsenic becomes conclusive; for no other known substance, says he, can yield with sulphuretted hydrogen a yellow precipitate from which a metallic crust can be sublimed. Professor Silliman says that "the reduction of the arsenic is perfectly decisive." After this we might well ask, what need is there of other tests?

But professor Michell has performed numerous experiments; and, having closely examined those made by Christison, come to the conclusion that the more he examined the subject the more he became convinced that, "for the ascertainment of the presence of arsenic, no single experiment was sufficient; and that the appearances, of even *the best marked and most characterestic crust*, *are not an infallible*, *or alone even a good test* of the presence of the potent poison." Rose declares that the free sulphur is always deposited along with the sulphurets precipitated from arsenical solutions by sulphuretted hydrogen, and which accounts for the yellow or yellowish red ring occasionally surmounting the metallic crust obtained by the reduction of the sulphuret of arsenic. Dr. A. Murray of Edinburgh is not satisfied with Christison's conclusions, and shows experiments by which, he says, it is easy to detect a quantity of arsenic, much less than the most skilful chemist can reduce to the metallic state. Few persons, says he, can depend upon reducing 1-20th or even 1-10th of a grain of arsenic; but he felt convinced that it is easy, by his method, to detect 1-1000th part of a grain; as a proof of which he took one grain of white arsenic, and spread it out as much as possible upon common writing paper; and, by means of the ammoniacal nitrate of silver, with great ease and even in a hasty manner, made upwards of 400 separate and distinct yellow spots. Dr. Paris recommends the suspected fluid to be dropped on a piece of white paper, making with it a broad line; along this line a stick of lunar caustic is to be slowly drawn several times successively, when a streak is produced of a colour resembling that known by Indian yellow. Dr. Murray denies that nitrate of silver produces change of colour with arsenic; but with a phosphate it readily occasions a beautiful yellow. Orfila is in the habit of testing by concentrated liquid hydro-sulphuric acid. He obtains the metallic arsenic, and specifies its physical properties.

Now, considering the importance of the question we have been examining, these conflicting opinions induce us to implore those who are likely to sit on British juries and gentlemen of the Bar, seriously to consider this difference of opinion; while we solemnly protest against any bold assurance of our chemical physicians lest they peril the life of a fellow creature on the uncertainty of an experiment.

Many of our profession, says Dr. Wm. Hunter, are a little disposed to grasp at authority on a public examination, by giving a quick and decided opinion, whereit should have been guarded with a doubt,—acharacter which no man should be ambitious to acquire, who in his profession is presumed every day to be deciding nice questions on which the life of a patient may depend.

The Jurist should remember the words of Shakespeare—

> "I have seen,
> When, after execution, Judgment hath
> Repented o'er his doom."

We are aware that archdeacon Paley objects to the maxim that we ought to bear in our minds, that it is better that many guilty escape than one innocent man suffer. But Male, the able author of Juridical and Forensic Medicine, quoting the work entitled "Considerations on the Criminal Proceedings of this Country," still maintains that the maxim is a good one.

On the conclusion of Dr. O'Shaughnessy's experiments, Mr. James Prinsep proceeded to show the intense heat produced and directed on different metals, by a jet of flame consisting of hydrogen and oxygen gases. The gases were discharged from separate gasometers, and brought in contact at the orifices of small diameters. The Drummond light, already described in our Journal, was exhibited. Dr. Wallich attended with a most perfect Ross's microscope, through which was distinctly seen the circulation or living principle of plants. The skeleton of an ox, prepared and set up by Mr. Pearson; numerous fossils; varieties of the Assam silk moth; Dr. MacClelland's collection of birds; very valuable specimens of Bactrian and other coins, collected by Mr. Prinsep, Col. Stacy, and Capt. Cunningham, and several plants, among which was the tea plant of Assam, were also exhibited. The whole party appeared much delighted, with the interesting and instructive entertainments.

LAW OF PATENT, TO USE NEW MANUFACTURES REQUIRED FOR INDIA.

So long as such a law is not mischievous, by raising prices of commodities, or hurtful to trade, we consider that it is essentially necessary for the protection of the property of individuals in this country. We should be glad to see a legislative enactment in favor of inventors, that those who labour with the intellect may be entitled to as effectual a protection as those who labour with the body. We are led to the foregoing observations from having observed, in the London Journal and Repertory of Arts, &c. for May last, a patent granted to Mr. Newton in March 1835, for a method of preparing animal milk, and bringing it into such a state as to allow of its being preserved for a certain length of time. We republish the article, in order to show our readers, that this, with very little alteration, is the mode by which Mr. Previte, now about to embark for England, has prepared his pulverized milk. We have obtained from Mr. Previte some information as to the cause of his not obtaining the patent to which he was so justly entitled, for his important discovery, which, being of interest to the British community in India, we do not hesitate to lay before them.

Mr. Previte's discovery being subjected to the examination of several eminent medical men was, after many experiments, pronounced to be pure milk in a dry state, retaining the flavor of milk in full perfection, imparting it to tea and coffee, as well as all culinary preparations where milk is required; and being, from its nutritious properties and freedom from acidity, well adapted for children and invalids.

As much attention, labour, and expense had been bestowed in prosecuting the experiments which led to the discovery, he applied, in a letter dated 14th May, 1834, to the Government, through the Secretary in the General Department, for a patent. The reply was that no law existed under which patents could be given by the Government of India to secure to the projectors or inventors of new machinery, or preparations of any kind, the property and exclusive benefit of their inventions. The propriety of eventually passing such a law, to give to the Government such a power, was to be considered by the Right Hon'ble the Governor General of India in Council. Two years and seven months have passed away, however, and the result is that the patent has been obtained by another person in Europe,—one who is not the inventor; for he acknowledges that it was *a communication from a foreigner residing abroad*. And thus it is, that unless the

law be granted in favor of Mr. Previte, the original inventor, his labour and expense must be lost. We consider this an exceedingly hard case, and we trust that it will induce the Government in India, without delay, to apply for a legislative enactment, for the protection of the right of inventors, &c.

The following is the patent which we copy from the London Journal.

To William Newton, *of Chancery-lane, in the county of Middlesex, civil engineer, for a method of preparing animal milk, and bringing it into such a state as shall allow of its being preserved for any length of time, with its nutritive properties, and capable of being transported to any climate, for domestic or medicinal uses; being a communication from a foreigner residing abroad.*—[Sealed 11th March, 1835.]

The method of preparing animal milk, and bringing it into such a state as shall allow of its being preserved for any length of time with its nutritive properties, and capable of being transported to any climate for domestic or medicinal purposes, consists in simply evaporating the aqueous parts from the liquid milk, and leaving the other constituent parts of the milk in a concentrated state, unaltered by any chemical change, which I effect in the following manner:—Taking the milk in a fresh state as drawn from the animal, having first strained it, if necessary, to get rid of any dirt or other improper matter which may have accidentally fallen into the pail or other vessel while milking; I introduce into the milk a small quantity of pulverised loaf sugar, say from one-fiftieth to one-hundredth part in weight of the whole quantity of the milk, which quantity may however be greater, dependant upon the desired sweetness of the preparation when completed. On the sugar becoming perfectly dissolved, I subject the milk to tolerably rapid evaporation, either by blowing through the milk warm or cold air, by means of suitable apparatus of any convenient form, such, for instance, as those at present in use for evaporating syrups, or by means of external warmth in connexion with a vacuum above the surface, produced in any of the ordinary ways as applied to evaporation. By whatever process, however, the evaporation is carried on, the milk may, with advantage, be subjected to a gentle warmth to quicken the operation; but that warmth will be best obtained from hot water, or from steam or heated air, applied to the outside of the vessel which contains the milk, as the direct action of fire upon the vessel may tend to injury the properties of the milk, and perhaps give it an unpleasant flavour. By evaporating the aqueous parts of the milk in this way, its nutritive or essential parts may be concentrated, and its substance reduced to the consistency of cream, honey, or soft paste, or even into dry cakes or powder; and may in the latter states be kept exposed to the air for a length of time without being impaired, the sugar tending to preserve it.

By dissolving the milk so prepared in a proportionate quantity of warm or cold water, the original milk is reproduced, with all its properties, original flavour, and salutary qualities.

It is desirable to dilute the concentrated milk at first in a small portion of water, and to add afterwards the necessary quantity to bring it into the liquid state; otherwise it would be difficult to dissolve the milk completely.

This process of preparing milk, affords the means of conveying it without injury to any distance in any climate, and of retaining by concentration the delicious flavour of the milk peculiar to one country, and reproducing it in another with its original qualities.

When evaporated to the consistency of paste, it may be taken as food by persons who, on account of the weakness of their digestive organs, cannot take milk in its liquid state.

It is obvious that every kind of animal milk may be prepared in the same manner, whether it comes from the cow, the goat, the ass, or even from the human breast.

When evaporated to the consistency of a syrup, it may be put in bottles or phials; when concentrated to the consistence of honey, in suitable pots; when brought to that of a thick paste, it may be shaped into lozenges, or dried and reduced to powder. Milk so prepared may, without losing any of its properties, be afterwards combined with any medicinal, aromatic, or nutritious substance.

When reduced into powder, milk may be advantageously mixed with cocoa, and dried into cakes; and by diluting it with warm water, will give excellent chocolate.

When brought to the consistence of honey, it may be mixed with a strong infusion of coffee, or of tea; and being further evaporated, will keep, and afterwards yield, when dissolved with warm water, coffee, or tea, of the usual strength and flavour.

This improved method of preparing milk is essentially different from all preparations of milk heretofore known; and is particularly unlike the preparation described by Mr. Braconneau, inasmuch as milk prepared upon his plan is decomposed; while by my process it is only concentrated, without being chemically changed.

The process of Mr. Braconneau consists in separating, by means of an acid, the serum from the other constituents of milk, and adding to the residuum (viz. the caseum and the butyrous substance) a sufficient quantity of carbonate of soda, to render it soluble in liquid. The milk so prepared must be recomposed for use, but it never can be brought to the perfect flavour and condition of real good milk, as many of its original properties are necessarily destroyed or modified, however exact the analysis, and however great the skill of the operator: on the contrary, the milk thus prepared by me undergoes no chemical change, but concentrated by its constituent substances are merely driving off or evaporating the aqueous parts; and the milk, with all its original flavour and nutritious qualities, will be again restored by the addition of simple water.—[*Inrolled in the Rolls Chapel Office.*]

PROGRESS OF SCIENCE,

AS APPLICABLE TO THE ARTS AND MANUFACTURES; TO COMMERCE AND TO AGRICULTURE.

PALMER'S PATENT EXCAVATING AND SELF-LOADING CART.

In this railway age an invention which is represented to be capable of effecting a saving of no less than "500 per cent." in the time and labour attending those fundamental railway operations, cutting and embanking, will be readily allowed to be one deserving of all possible attention. Whether so prodigious a saving could be actually realized by the apparatus we are about to describe, practice only can determine; and, for the present, we are inclined to think that to expect so much from it, is to take rather a sanguine view of its capabilities. But we are sure every mechanical reader will join with us, at all events, in admiring the ingenuity and skill with which it has been constructed.

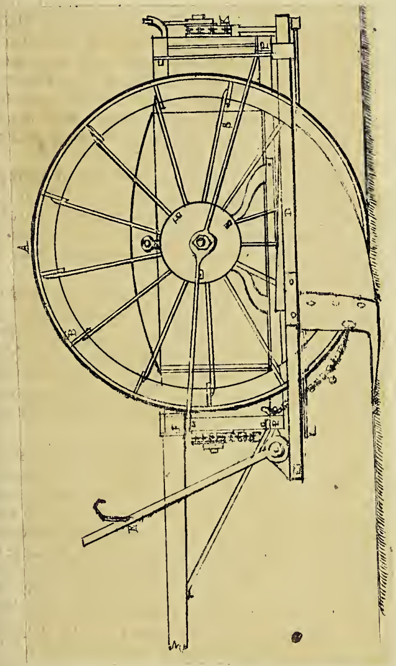
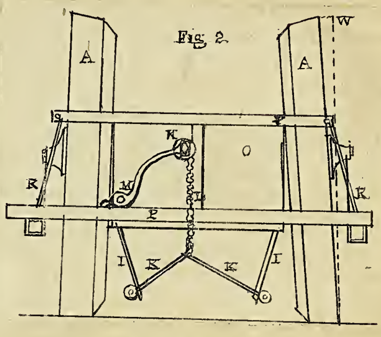


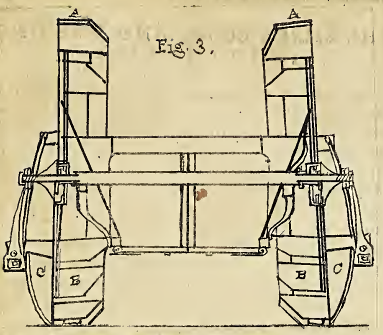
Fig. 1 is a side elevation of Mr. Palmer's excavating and self-loading cart; fig. 2, an end-view; and fig. 3, a sectional view through the axle.

Fig. 2.



The cart, it will be seen, is of the ordinary size; it may be drawn by one or two horses, and will hold half a ton. A A (fig. 2.) are the wheels, the rims of which are hollow, open on the inside, and divided by the projecting partitions B B into as many separate chambers as there are spokes; C C are iron cutters or excavators, resembling ploughshares, one to each wheel, which scoop out the earth and throw it upon the projecting partitions B B, which, as the wheels revolve, discharge the earth into the body of the cart H; D is a beam, to which each excavator is secured by two strong bolts; and E, a lever, with a hooked termination, to which a chain G, proceeding from the excavator D, is attached, so that by the turning of this lever the excavator may be adjusted to any depth required, or raised altogether when the cart has completed its load. The means provided for emptying the cart are shown in fig. 2. The bottom is divided into two parts II, which are connected by the bars K K to a chain L, which passes round a projecting iron rod or pulley N. M is a winch-handle, which, being applied to the rod N, opens or shuts the bottom leaves of the cart at pleasure. P P are strong horizontal bars, made fast to the body of the cart, both in front and at back; R R, diagonal braces, which connect the upper and lower bars P P; and S S, braces, proceeding from the nave of the wheel to the bars P P. On the uppermost of these bars, immediately above the letter O, there is a stopper to retain the winch handle when necessary.

The cart is stated to have been "seen at work by many engineers, who have all given their most decided approbation of it." A model of it may be seen at Mr. Hendries', in Oxford-street.



Mr. George Vaughan Palmer, the inventor, is now, we regret to say, numbered with the dead. In a slight biographical notice of him, with which we have been favoured by a friend, it is stated that he was a native of Worcester, where he was born, June, 1786; and a descendant of the ancient family of the Vaughans of Trebaried, county Brecon, and Hargest Court, Herefordshire. From early infancy he evinced a strong taste for mechanical pursuits; and, had he been longer spared to the world, would probably have risen to eminence as an inventor. Great part of his time was devoted, for some year previous to his death, to the construction of his excavating-cart; and he had but just completed, and secured his right to it by a patent, when he was seized with a rapid decay, of which he died in June, 1834, leaving a widow and four children, for whose benefit the patent is now to be sold.—*Mechanics' Magazine.*

STEAM-PLOUGHS.

The adaptation of inanimate power to the tillage of the soil must evidently have been considered by practical men to present almost insuperable difficulties, or steam would, probably, long since have been substituted for horses and oxen, as the moving power of agricultural implements. Certain light operations of the farm, such as thrashing, churning, chaff-cutting, &c., which could be performed by fixed power, have partially occupied the attention of mechanics, and suitable machinery driven by water, wind, or small steam-engines, has to some extent been advantageously used for such purposes. But the idea of a "steam farm," of a farm to be altogether cultivated by steam, in lieu of animal power, has hitherto been treated as visionary and absurd, except by a few individuals, and one or two agricultural societies, who have enforced, in their publications, the practicability and importance of applying steam to effect the more laborious operations of agriculture.

This desideratum is at length accomplished. Mr. Heathcoat, M.P. for Tiverton, the ingenious and well-known inventor of the lace machinery, has the merit of having conceived and planned this additional and remarkable contribution to science, and to the wealth of his country. The invention, after years of costly experiment, has been matured and perfected through the enterprising liberality of Mr. Heathcoat, assisted by the mechanical ingenuity and perseverance of Mr. Josiah Parkes, civil engineer, whom he selected to carry his designs into effect. The first machine has been constructed expressly for the cultivation of bogs, and has, for some months, been practically and successfully worked in Lancashire, on Red Moss, near Bolton-le-Moors.

During the Whitsuntide recess of Parliament, a numerous assemblage of gentlemen from different parts of the country attended to witness an exhibition of this novel and interesting invention; amongst whom were Mr. M. L. Chapman, M. P., Mr. T. Chapman, Mr. H. Handley, M. P., Mr. J. Featherstone, of Griffinstownhouse, Westmeath (an enterprising and successful bog reclaimer), Mr. F. Brown, of Welbourn, Lincolnshire, Mr. James Smith, of Deanstone, near Stirling (well known to the mechanical world by his ingenious inventions, applied both to agriculture, and manufactures), Mr. B. Hick, and Mr. P. Rothwell, engineers, with other experienced judges of mechanical contrivances. These gentlemen were unanimous in pronouncing the invention to be the germ of great improvements in the science and practice of agriculture, as well as eminently fitted for the particular purpose to which it has, in the first instance, been applied. Two ploughs of different construction were put in action, to the admiration of the spectators; particularly the one last invented, which is double-acting, or made with two shares in the same plane, so that it returns at the end of a "bout," taking a new furrow without loss of time. The perfect mechanism of this plough—the action of the working coulters and under-cutting knives, which divide every opposing fibre of the moss—the breadth and depth of the furrow turned over—the application of a new and admirable means of traction, instead of chains or ropes—together with the facility with which the machine is managed, and the power applied to the plough, especially interested and surprised all present. The speed at which the plough travelled was $2\frac{1}{2}$ miles per hour, turning furrows 18 inches broad by 9 inches in depth, and completely reversing the surface. Each furrow of 220 yards in length was performed in somewhat less than three minutes, so that in a working day of twelve hours, this single machine would with two ploughs turn over ten acres of bog land!

The machine which bears the steam-engines is itself locomotive; but as the ploughs are moved at right angles to its line of progress, not dragged after it, the machine has to advance only the width of a furrow, viz. eighteen inches, whilst the ploughs have travelled a quarter of a mile; in other words, the machine has to be moved only eleven yards, in the time that the ploughs have travelled five-and-a-half miles, and turned over a statute acre of land. This is, in truth, the prime distinguishing feature of the invention; it is the contrivance on which the genius of its author is more particularly stamp-

ed, and which seems to be essential to the economical application of steam to husbandry; for it is evident, that were it requisite to impel the machine with a velocity equal to that of the ploughs, by dragging them with it, a great proportion of the power of the engines would be uselessly expended.

Another valuable property appertaining to the machine, and which conduces greatly to its economy as a bog cultivator is, that it requires no previous outlay in the formation of roads, no preparation of any kind further than a drain on each side of it. That a locomotive machine of such great dimensions and power could be so constructed as to travel on mere raw bog, was an excellence the more appreciated as it was unexpected by those persons who are conversant with the soft, unstable nature of bog. The Irish gentlemen present also pronounced Red Moss to be a fair specimen of the great mass of the flat, red, fibrous bogs of Ireland, and that neither the machine nor the ploughs would have any difficulties to encounter in that country which had not been already overcome on Red Moss, the field of experiment. The engines are capable of working up to fifty horses power, but the operations subsequent to ploughing will require a small force compared with that necessary for breaking up the surface of the bogs, to the depth and at the speed effected by these ploughs. The power consumed by each plough is estimated at about twelve horses, and the weight of the sod operated upon by the plough, from point to heel, is not less than three hundred pounds. The boiler is of unusually large dimensions for locomotive engines, being suited to the use of peat as fuel, so that the culture of a bog will be effected by the produce of its drains. At Red Moss, however, coals are so cheap, being found contiguous to and even under it, that they are used in preference to turf. Eight men are required for the management of the machine and the two ploughs, or at the rate, nearly, of one man per acre, but it must be understood that this number of men will only be required for the first heavy process, and has no relation to any subsequent operations in the cultivation of bogs, nor to the application of the invention to the culture of hard land.

After passing a sufficient time on the Moss to witness the exhibition of the ploughs, and the various other functions and properties of the machine, the party expressed to Mr. Heathcoat the extreme pleasure they had received, and their earnest hope that he would extend the sphere of his exertions by applying the invention to the culture of stiff clay soils; and more especially to carry into effect those important operations of sub-soil ploughing and improved drainage recently introduced to the agricultural world by Mr. Smith, of Deanston. To effect these processes, great power is essential, and it was evident that Mr. Heathcoat's invention was equally well adapted to them, and would be attended with results no less important than those which will arise from its application to the reclamation and culture of bogs.—*Morning Chronicle.*

THE SILICA SOAP, AND WASHING WITH PIPE-CLAY.

Sir,—I have just observed in your Magazine for last month an article from Dundee, relative to the use of pipe clay as an auxiliary to soap. In corroboration of the facts stated therein, I beg leave to say, that I and some of my friends have for many years been in the habit of using a silicious clay or species of soap-stone, both in solution with water and in combination with soap, and have found it to possess such valuable detergent qualities, as to effect a considerable saving in that article.

I am not aware whether pipe-clay, or a clay such as mine, be the better material, the former you know is highly aluminous, while the principal constituent of that on my land is silex, and differing, I should think, very little, if at all, from the pulp of flint; for the use of which, in the manufacture of soap, you noticed in a late Number that a patent had been obtained.

I am, Sir,
Your obedient servant,
I. S.

Dublin, June 20, 1836.

ORNAMENTAL SLATE MANUFACTURE.

Slate has of late years become extensively useful, and its application to new purposes is of every-day occurrence. A Mr. Stirling has for some time been labouring to bring it into use as a material for the manufacture of various articles of furniture, and, from the specimens which we have seen, we think it likely that he will meet with complete success. Tables of all kinds, sideboards, wash-hand stands, other articles of a similar nature, and which do not require to be often moved (as slate is, of course, heavy), may be made of it, decorated in the most elaborate style. The natural texture of the slate, it has been found, is peculiarly applicable as a ground for the reception of colours; and Mr. Stirling has some specimens of tables with a wreath of flowers round the edge, and group in the centre, most beautifully executed—the neutral tint of the slate forming an appropriate back-ground. A very beautiful and appropriate application of the article has been made in the formation of door-panels. The General Steam Navigation Company has, we understand, given orders for the fitting up of the saloon of one of its new steam-vessels with these panels, painted with groups of fruit, flowers, and designs of a like nature. Amongst the numerous other articles of slate manufactured by Mr. Stirling, we shall merely particularise his door finger-plates and inkstands, which are extremely beautiful.

WOOD-POLISHING.

The Persians have introduced an entirely new mode of polishing, which is to wood precisely what plating is to metal. Water may be spilled on it without staining, and it resists

scratching as well as marble. The receipt is as follows:—To one pint of spirits of wine, add half an ounce of gum shellack, half an ounce of gum lack, half an ounce of gum sundrick; placing it over a gentle heat, frequently agitating it until the gums are dissolved, when it is fit for use. Make a roller of list, put a little of the polish upon it, and cover that with a soft linen rag, which must be slightly touched with cold-drawn linseed-oil. Rub the wood in a circular direction, not covering too large a space at a time, till the pores of the wood are sufficiently filled up. After this, rub in the same manner spirits of wine, with a small portion of the polish added to it, and a most brilliant polish will be produced. If the outside has been previously polished with wax, it will be necessary to clear it off with glass paper.—*American Railroad Journal.*

SLATE TOP FOR WASH-HAND STANDS.

Sir,—The Caernarvon blue slate, like India-rubber, is used for various purposes. Could it not be used for the table part of wash-hand stands?* Not that it would be as beautiful as white marble, but that it would be handsomer than painted wood, with the paint half washed off, which is too often the case *with* that article of furniture. After polishing the slate, were figures cut in it, possibly it might be made to retain paint; or a kind of mosaic work might be made of it by inserting pieces of white marble in it; or other means might be used to ornament it.

Yours, &c.

An Amateur Mechanic.

OBTAINING A POWER FOR PROPELLING CARS, BOATS, &c.

Alexander M'Grew, Cincinnati, Ohio.—My improvement does not consist in the employment of any newly-invented machinery, but in the using of such power from falls, or currents of water, or other natural or artificial sources of power, as has heretofore been allowed to run to waste, and employing the same for the purpose of condensing of air into suitable receivers; the elastic force of which condensed air is to be subsequently applied to the purposes herein designated. In numerous situations in the courses of canals and railroads, and of other roads and water courses, there are falls of water, waste weirs, dams, sluices, &c., the power from which, if economised, would be ample for the attainment of all the ends proposed by me; I bring this into use by taking the waste power from wheels, or other machinery already erected, or by erecting others where they do not already exist, using any of the known constructions of such wheels, or other machinery, as may be best adopted for the particular situations in which they are to be employed; these I connect in the ordinary way with the piston, or pistons, of condensing engines, constructed for the condensing of air, and force air thereby into suitable receptacles, or reservoirs, furnished with the requisite tubes, valves, or other appendages, by which they are adapted to the containing of the air thus condensed, and the supplying of the same in measured quantities, so as to operate upon a piston for driving and propeling machinery, as high steam is now made to operate. The means of doing this does not require any description, being perfectly familiar to competent engineers. The air is to be condensed into one large stationary reservoir, and, by means of a connecting-tube and stop cock, transferred therefrom into other reservoirs connected with the vehicle to be propelled. What I claim as my improvement in the art of propelling cars, boats, or other vehicles for transportations, is the employment of the waste power of water, wind, or other natural or artificial sources of power, to the condensation of air, in the manner, and for the purposes, hereinbefore set forth.

REMARKS BY DR. JONES.

It has been repeatedly proposed to drive railroad-cars, &c., by means of condensed air, instead of by steam, and to erect stationary engines for the purpose of filling the requisite reservoirs, and we believe that the thing was attempted in England. Were there not serious practical objections to the plan, it would certainly present many advantages, but these are so weighty, that they are not likely to be removed. Among them is the perpetually diminishing power of the condensed air, as every stroke of a piston must lessen its elastic force; to graduate the quantity emitted from the reservoir, in proportion to this diminished force, would be very difficult; and, besides this, there ought, when the reservoir is renewed, to be a pressure of several atmospheres above what is required in a steam-boiler, or it will soon be so far exhausted as to be inadequate to the production of the intended effect, as they would have to be exchanged whilst under a pressure of two or three atmospheres.

The present patentee does not propose to remove the foregoing, or any other objection to the use of condensed air, excepting it be the necessity of erecting stationary engines to effect the condensation, and to accomplish this, he depends upon the employment of means which would generally be more difficult, precarious, and expensive; in many places, the means of condensation proposed to be used would not be found within many miles of the stations where the reservoirs would be wanted, and there are, in fact, but few situations where the means of applying waste power would not be a costly undertaking.

* This application of slate has already been made by Mr. Stirling. See *Mech Mag.* p. 231.

ON THE USE OF PIPE-CLAY IN WASHING.

Sir,—I take this opportunity of observing, in respect to the use of pipe-clay in washing, as noticed in the extract from a Dundee paper, at p. 80 in your 665th Number, that the discovery is by no means a new one.

The detergent properties of pipe-clay, fullers-earth, and other saponaceous clays, have been long known and taken advantage of both in domestic economy and in various manufacturing processes. In the army, and in the navy in particular, pipe-clay has been long and extensively employed in washing and whitening of wearing apparel and is well known to increase the effect, and reduce the quantity of soap and labour necessary to produce the effect required; although the actual saving of both is somewhat overrated in the article quoted as above.

There is no question but that a more extensive diffusion of a correct knowledge of the real properties of these substances, which are in many places exceedingly abundant, will tend to produce increased economy in the application of two costly materials—soap and labour.

I remain, yours respectfully,
W. Baddeley.

Birmingham, June 27, 1836.

ELECTRIC CURRENTS.

At a late meeting of the Royal Society a paper was read "On the reciprocal attractions of positive and negative Electric Currents whereby the motion of each is alternately accelerated and retarded," by P. Cunningham, Esq. Surgeon, R. N., communicated by Alexander Copland Hutchison, Esq. The following abstract of which we quote from the *Athenæum*.—

"The author found that a square plate of copper, six inches in diameter, placed vertically in the plane of the magnetic meridian, and connected with a voltaic battery by means of wires soldered to the middle of two opposite sides of the plate, exhibited magnetic polarities on its two surfaces, indicative of the passage of transverse and spiral electrical currents, at right angles to the straight lines joining the ends of the wires. The polarities were of opposite kinds on each side of this middle line, in each surface; and were reversed on the other surface of the plate. The intensities of these polarities at every point of the surface were greatest the greater its distance from the middle line, where the plate exhibited no magnetic action. The author infers from this and other experiments of a similar kind, that each electric current is subject, during its transverse motion, to alterations of acceleration and retardation, the positive current on one side of the plate, and the negative on the other, by their reciprocal attractions, progressively accelerating each other's motions, as they approach, in opposite directions, the edge round which they have to turn. After turning round the edge their motion will, he conceives, be checked, by coming in contact with the accelerated portions of the opposing currents to which they respectively owed their former increase of velocity; so that the one current will be retarded at the part of the plate where the other is accelerated. To these alternate accelerations and retardations of electric currents during their progressive motion, the author is disposed to refer the alternate dark and luminous divisions in a platina wire heated by electricity, as was observed by Dr. Barker."

PATENT ROTARY PRINTING-APPARATUS.

A patent has recently been taken out by Mr. Rowland Hill for a rotary printing-machine. The types are imposed* upon cylinders, to which they are firmly attached, and of which, except the marginal spaces, they occupy the whole surface. The pressure is given by blanket-covered cylinders of the ordinary construction.

The most important advantages of this arrangment are stated to be, first, That as the revolving type cylinder is constantly receiving its ink in one part of its revolution, and constantly impressing the paper in another part, the action of the machine is unceasing; whereby a saving of time of about three parts out of four is obtained in comparison with the ordinary printing machines, when moving at the same velocity; because in those machines the backward motion of the form,* and the laying on of the ink, suspend for the time the process of printing. Further, as the motion of the type in this machine is continuous instead of reciprocating, the speed has been increased without difficulty or danger; and by this additional velocity, combined with the saving of time just described, the rate of printing is brought to about ten times that of the ordinary perfecting machines, *i. e.* those which print the sheet on both sides before it leaves the machine. Secondly, the reciprocating motion of the heavy form, inking table, and inking rollers of the ordinary machine entails such a loss of power and time, in comparison of the rotatory motion which is here substituted for it, that it is believed, from careful observation, that, notwithstanding the great increase in speed, any given quantity of work will be executed at the expense of about one-eighth of the power required in the ordinary machine.

The facilities provided for fixing the type, detaching parts for correction, appplying the ink, and regulating its supply, are said to be fully equal, if not superior, to those of other machines.

Compared with the rapid machines used for printing the daily newspapers, the rotatory machine will print two sheets on *both* sides with accurate register*, while they print *one* sheet on one side with defective register.

* These words are used technically.

ELECTRICAL EXPERIMENT.

A salad, consisting of mustard and cress, may be produced in a few minutes by an electric experiment. The process is to immerse the seed for a few days previously in diluted oxymuriatic acid, then sow it in a very light soil, letting it be covered with a metallic cover, and next bring it in contact with the electric machine. By the same agents employed in this process, eggs which require from nineteen to twenty-one days' application of animal heat to hatch them, may be hatched in a few hours. Rain water, apparently free from any noxious animalcula, in an hour can be rendered full of living insects. Water, in a short period, decomposed of its two component parts, oxygen and hydrogen, and by the same power restored to its former state; and platina, the most difficult of all metals to melt, in a moment can be fused and calcined by the discharge of an electric battery. An iron bar, by the discharge of a sufficient accumulation of the electric fluid, will become magnetic to such a degree as to lift more than its own weight; and if a pound of red lead and a pound of sulphur be mixed together into a mass, which no human ingenuity can separate, a stream of the electric fluid will do it at once.—*Cambrian.*

INGENIOUS PIECE OF MECHANISM.

A very ingenious piece of mechanism, a miniature steam-engine, has been constructed by Mr. Richard Corfield, a young man in the employment of Messrs. Gittins and Cartwright, at the Eagle Foundery, Shrewsbury. It consists of an engine not exceeding an half inch cylinder, for the purpose of propelling a steam-boat, working its propelling shaft at the enormous speed of five hundred and fifty revolutions per minute—travelling a distance of thirty miles in one hour. The boiler is so constructed as to admit a spirit-lamp in the centre of the water, which affords sufficient fuel and steam for one hour. We should add, that the above is only one of many extraordinary specimens of useful, though miniature and elaborate, works of art made by Mr. Corfield.—*Ibid.*

BERLIN IRON ORNAMENTS.

Some of these are so fine, consisting of rosettes, medallions, &c., that nearly ten thousand go to the pound. In the coarse fabrics the value of the material is increased by manufacturing eleven hundred times, and in the finer nearly ten thousand times.—*Arcana of Science.*

THE QUADRANT.

In 1734 it was said, " as soon as the common prejudice against new things is worn off, and the instrument is well known, I do not believe any ship will go on a long voyage without one of these excellent quadrants."

THE RAILWAY SYSTEM.

A railway between Liverpool and Manchester, two towns of immense population, at a distance of little more than 30 miles, one the commercial, and the other the manufacturing capital of the great " northern line" of England,—has succeeded to such an extent, that (aided by the attraction of its novelty, which draws passengers to it not only from all parts of Great Britain, but of the Continent,) it pays the shareholders between 9 and 10 per cent. on their capital.*

And this amazing result has been sufficient to transform us all into a nation of speculators! Encouraged by this dazzlingly brilliant success, having this proof positive before us that a line of railway, in perhaps the most advantageous situation that could possibly be selected, will actually yield a *something* over and above its expenses, we are ready at the first blush to yield assent to the very reasonable proposition, that every peddling market-town ought forthwith to be accommodated with a road, costing the trifling sum of 30,000*l*, a mile!† If the Liverpool and Manchester has paid 100 per cent., instead of 10, the rage for railways could hardly have been greater than it is at present. " Can these things be, and overcome us like a summer cloud, without our special wonder?"

* * * * * *

In point of cheapness, steaming by land can hardly ever equal steaming by water. We cannot expect, either on common road or railway, to be conveyed to Hull for two shillings—the present fare by sea (a distance of at least 300 miles;) nor, even if the suspension-bridge across the British Channel were fairly erected, could the journey to Boulogne well be effected for less than five shillings, the present rate per steamer. Notwithstanding this, I believe it seldom happens that a railway projector does not calculate upon securing every particle of traffic on his line,

* We do not think this is by any means a fair view of the case. The Liverpool and Manchester Railway is by no means the only one which has furnished an example of great success to stimulate and justify the prevailing fondness for railway speculations. The Stockton and Darlington has paid still better than the Liverpool and Manchester, and is the older line of the two, (can it be that our intelligent correspondent has never heard of it?) the Edinburgh and Dalkeith, and the Dublin and Kingstown, are also yielding handsome returns to their respective proprietors. It deserves further to be observed, that the dividends of the Liverpool and Manchester Railway Company are *limited* by their Act of Parliament to 10 per cent. (a limitation introduced through the influence, and for the protection, of certain canal-owners): and that but for this circumstance, they might be a great deal higher than they are. The limitation of the dividends has the natural effect of keeping up the rates of conveyance, and these again of restricting the amount of traffic.—ED. M. M.

† This is the maximum rate. In many cases the expense does not amount to 10,000*l*. a mile; in some it is as low as 6,000*l*. and 7,000*l*.—ED. M. M.

to the exclusion of every other mode of transit. The possibility of competition as an element, that never enters into the composition of a railway prospectus; the fortunate shareholders of the concern whose glorious prospects are being held out to view, are always to *engross* the whole trade, not only of their own line, but of all the neighbouring country, although perhaps at the same time half-a-dozen other rail-roads are projected in the immediate vicinity.

NEW POWER.

We learn from Frankfort that there has been communicated to the Society of Natural Sciences of that city a discovery of a new motive power, created by means of a galvanic battery, the action of which will supersede the use of steam, be more powerful, much less expensive, and less dangerous.—*Morning Herald.*

A NEW LIGHT OF THE AGE.

In the course of a recent lecture on the properties of caoutchouc, Dr. Birckbeck introduced to public notice a pair of candles made of that material, at his own suggestion. After many unsuccessful attempts, they were at length fairly lighted; and it is only justice to the worthy Doctor to say, that his invention is likely to prove of great importance, whenever it shall come to pass that candles which are very difficult to light, which burn badly and gutter immensely when they *are* lighted, and which pretty soon go out of their own accord, are considered a desideratum. Until then, those less expensive, but more appropriate articles—tallow and wax—are likely to remain in general use for the purposes of domestic illumination.—F. H.

CHEAP LOCOMOTION.

Such is the march of competition abroad, that (if we may put faith in coach-proprietors' advertisements) the whole fare by diligence from Boulogne to Paris is only nine shillings. If this were quite true, the journey from London to Paris throughout might be performed for no more than fourteen shillings, the fare per steamer to Boulogne being only five! The fact however is, we believe, that what with the regular fee of the French conducteur, and other extras, the trip can hardly be expected to cost much less than a sovereign, or *fully three farthings a mile!*—F. H.

A HINT.

Mr. Alderman Wood, by his recent accession of fortune, under the will of his namesake Gloucester, enjoys a rare opportunity of immortalising his name. It is well known that the Alderman, some short time back, promulgated a plan for the general improvement of London, among other things, by throwing open Waterloo and Southwark Bridges toll-free to the public; erecting a new street from the Mansion House to Southwark Bridge; straightening the upper end of Holborn, so as to effect a direct junction with Oxford-street; and executing divers other plans of unquestionable utility. And all this, and more, the Alderman calculated (it is not known by what elaborate process) might be done at an outlay of only 800,000*l.*! By a turn of Fortune's wheel, the projector of these mighty alterations has this sum at his own disposal; and how could he more gloriously display his civic patriotism than by carrying into effect his magnificent ideas for changing the whole aspect of the metropolis over which he twice presided as Lord Mayor? It is to be feared, however, maugre his own estimate, that he would arrive at the bottom of his purse, some time before he had got to the end of his trifling undertaking.—F. H.

FRENCH THEORY AND ENGLISH PRACTICE.

It is not a little singular, that, while England is making so great a progress in the actual establishment of railways, the French have published a much larger number of works on their mathematical theory; although this is, perhaps, not by any means the first instance in which the same state of things has occurred. A Colonel de Pambour has just added to the rather long list of publications by his countrymen on the subject, a very elaborate book of calculations on railway theorems, in which he lays down his positions rather more dogmatically than his little experience (all apparently gained in England) seems to warrant. He has not, however, much to fear from his English competitors in the line, the principal of whom are Mr. Macneil, of "canal navigation" celebrity, and—John Herapath, Esq.!—F. H.

TRUTH STRONGER THAN FICTION.

It is a well-ascertained, but rather unaccountable fact, that, notwithstanding the amazing increase of late years in the manufacture of steel pens, there has not been the slightest falling off in the extent of the quill trade.—E. H.

APPLICATION OF THE RISING AND FALLING OF THE TIDE TO THE PROPELLING OF MACHINERY, HENRY B. FERNALD, PORTSMOUTH, MAINE.

A buoy of sufficient strength and dimensions, connected by a rope or chain passing from the buoy under a pulley at the bottom of the water, with a wheel which moves the machinery. In the falling of the tide, or water, the weight of the buoy, filled with water by means of a stop-cock, or otherwise, operates as a propelling power, being so connected by another rope or chain to another wheel, as to operate alternately with the wheel above-mentioned.

"What I specifically claim as my invention or discovery, is the principle of applying the rising and falling of the tide, and other water, to the propelling machinery."

A patent was granted on the 23rd of December, 1829, to Henry M. Webster, for a "tide power," in which it is said that "the object which the subscriber proposes to effect is to bring into value and use the rise and fall of the tide on the seaboard, and particularly in the principal cities of the Union, to be employed in manufacturing and other purposes."

The two plans, it will be seen, are identical; in the first patent it is proposed to use "vessels or floats of great weight and buoyancy," "a condemned or other hulk of a ship of required size," being mentioned as suitable for the purpose.*

LITERAL SPELLING.

Sir,—It is an old maxim, to begin when you can with the egg; and in this age of many beneficial and some Utopian reformations, I am of opinion it would be beneficial to reform the mode by which our infants are first taught to read, and that would be effected by the abolition of absurd *literal* spelling. *The words of our language are made up of the sounds of its syllables, and not of the sounds of its letters;* and if so, why are the sounds of those letters taught? Several attempts have been made by Berthaud, Mr. Williams, and Anti-spelling, to accommodate the sounds of the letters to their sounds in words; but I would reform it altogether, and abolish them. This may be thought too sweeping a measure, but if your readers will take the trouble of examining, they will find that *literal* spelling is altogether time lost and worse. Let them try the word leg—*l, e, g*. What are these sounds, *leg* or *elegy?*

This foolish system is not followed in teaching music or French. A French master teaches his pupils the sounds of the French letters separately, as *aw, bay, say,* &c.; but he does not go on with this system, and say, "Now, my pupil, *vay-o-oo-ace—voo* (vous): *tay-o-oo-tay—too* (tout)." It is too absurd and round about. He says at once, "Look at that *vous*, it is *voo*; at that *tout*, it is *too*; don't forget, they are *voo* and *too* in sound, and *vous* and *tout* in sight;" and he remembers accordingly.

There is a strong and prominent feature in most (perhaps all) languages, and that is, the abundance of *short vowels*; they suit the early state of speech, whether in infants, as *ba, ma, pa, mam, pap, dad*—or in low-cultivated nation, as the Eskimaux, in *Ikmal-lik, Tussarkit, Tennitarpin,* &c. These short sounds far outnumber all the other vowel sounds put together; and if all others were expunged from our tongue, they would still form a language capable of conveying an extensive range of ideas. I would only have to do with *syllables*, as distinct sounds, at first. A child can tell this:—"*&* is and, and why not this, *and*? this is *g*, and why not this, *jee*? this *z*, why not this, *zed*?" Let any one dissect an English word as it is now first taught, and divide it into the *simple sounds* of which it is composed, and he will immediately find out that a child (poor thing) is instructed first to utter a number of simple sounds, and then expected to combine them into a compound sound, of which they do not form the elements or component parts. The child is first taught that this letter *a* sounds like *hay*; but perhaps the first syllable which it sees the letter in (*ab*) falsifies its previous instructions, for the letter *a* does not sound like *hay*, but somewhat like *hah*—and if it meet with the letter in the word *all*, it sounds neither like *hay* nor *hah*, but like *haw*.

I think the most judicious beginning would be to teach these first short vowel sounds unmixed. I intended publishing a first book on this plan, and had two sheets of it printed, but as I may not do so, I beg room for these remarks in your very useful work, and shall be glad of any comments upon them. My lessons are all of the following kind, reserving other vowel sounds for a higher grade or second book:—

ab, ad, ak, al, pa, ra, sa, ta, dad, dan, fan.
ed, ef, ek, en, beg, bed, bet, peg, pen, jet.
ib, id, ik, in, it, ix, fit, pil, din, nit.
ob, od, of, on, op, ox, bob, rob, pon, top.
ub, uf, us, ut, um, up, nup, rub, sud, sun.
on it, an ox, it is, if it is, is it up, or at it.
in a cap, it is a bat, mix it up, dad or mam.
run not in mud, pin her cap on, Tom cut his pen.
It cannot fit him, it is a bad job, it is as big as an ox.
It is a bad peg for his job, but Bob can lop it a bit for him.
Put it in a jar, or a cup, in his gig, but let him not sit on it.
Her bonnet is formal, but it is velvet.
Benjamin cannot get it into his cabinet, &c.

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* The application of the tides as a motive power was suggested and discussed in the *Mechanics' Magazine*, vol. xvi. pp. 375 and 436, and vol. xix. p. 167. The first mode proposed by our then correspondent differed altogether from either of these which have been patented in America. Dr. Gregory, too, in his "Mathematics for Practical Men," mentions that tidal power has been applied to pulling out old piles from rivers.—Ed. M. M.

In these first lessons, all long, or other than short, vowels are excluded, so that when a child has once learned the sound of a vowel or letter, it continues the same (a very few anomalies excepted) through the book.

I remain, Sir,

Your most obedient servant,

SAXULA.

AERIAL LOCOMOTION.

Sir,—I was amused with an idea of one of your correspondents, that birds might be trained for aerostation; and as I have since 1826 had various thoughts on locomotion by mechanical means, I beg leave to lay before your readers my ideas on locomotive-balloons. In the first place, the form of body should resemble that of a fish of great velocity--salmon or bonetta. Next, I would have in the centre of the body a fan-blast, or bellows, the vent being at the tail; and beneath the belly a stage should be hung by copper rods, on which the winch to act on the fan-blast should be fixed. At the tail end I would have a large fan, to act as a rudder; and on each side of the body a sort of fin, to regulate the rising and falling, acted on by strings or cords held by the person at the tail-fan. It is not necessary to go to great altitudes; therefore I propose that the gas to fill the body should be only in sufficient quantity to render the whole mass of the same specific weight as the atmosphere, or a trifle less—then by working the fan, motion would result. To progress, a nearly fair wind should be blowing, as this mode of transit can only resemble the compound forces of a river and a boat crossing, which produce diagonal motion; hence I consider the solution of the problem more curious than useful.

I had an idea of propelling vessels in a nearly similar manner, but have given it up for one more original, and perhaps better, as it will not require any sort of direct action of machinery on the water. The result will have all the appearance of a common sailer; and for a vessel of war, all will be entirely out of the reach of shot; steam or other power will, of course, be required as usual.

I am, &c.

KENANS.

April 30, 1836.

BRITISH IRON TRADE.

[Extract of a letter from Mr. Gerard Ralston to the Editor of the *American Railroad Journal.*]

In my last letter you will recollect I mentioned that the following advances in price had taken place in common (Welch) bars, viz.

On 25th August the price at New port and Cardiff was per ton.................		5*l*. 10s.
On that day the manufacturers advanced the price	10s.	
September 12th they advanced it again	10s.	
October 2d	10s.	
December 1st	12s. 6d.	
		2*l*. 2s. 6d.
		7*l*. 12s. 6d.

Thus you see there has been a further advance of 12s. 6d. per ton since my letter to you. But the price of 7*l*. 12s. 6d., as fixed by the meeting of Welch iron-masters at Romney, on the 1st inst., is not observed by some of the leading houses, who refuse to sell under 8*l*. per ton, and others decline orders at all, for the present, alleging that their engagements are already so heavy, and the prospects of the trade are such, that they prefer to confine themselves to the execution of orders on hand, and thus enable them to take advantage of increased prices in the spring. The meeting at Romney adjourned to assemble again on the 12th January next, when it is confidently expected the price of 8*l*. will not only be generally confirmed, but that a further advance of 10s.* The iron market is in a most extraordinary state; the demand is far greater than the supply, which it is impossible to increase immediately, owing to the inability to obtain competent workmen to mine the coal, ironstone, and limestone, and to manufacture them into iron when procured. Aid cannot be expected from the lead, copper, tin, and other manufacturers of metals, which would be practicable if these branches were in a depressed state; but so far from this being the case, these trades are in nearly as flourishing a condition as the iron trade. Hitherto the iron-masters always considered themselves fortunate, if they could get through the winter without a decline in prices. *Now, in the month of December*, the effort of the most judicious among them is to prevent too frequent and too great advances of price, which they deprecate, lest consumption should be checked; and also, what they fear more than any thing else, the workmen should combine, and 'strike' for higher wages.

You may inquire what effect has been produced on railway iron. I can answer, by quoting my own experience. I have within a week received an order for a very large quantity (so large that I have not revealed it to any one lest it should affect the market,) of railway iron from America. I have issued my circulars to all the houses in this line, and I find a most wonderful alteration in the tone of their communications; formerly they were all eagerness to give an answer by return of mail, and they manifested the greatest anxiety to secure the whole order, or as much of it as possible. Now, some of them decline making tenders altogether, owing to the magnitude of engagements on hand; others, rather than break off connexions, mention such high prices for very small parts of the total quantity wanted, that they think they will not be accepted. A decided indisposition is manifested to come under any further engage-

* The present price (June 6th) of British bar-iron is 12*l*. per ton.—ED. M. M.

ments, unless at exhorbitant prices, until it is ascertained what will be the result of the adjourned meeting at Romney on the 12th January. I very much fear that the same pattern of rail, which I put out in the middle of September last at 8*l*. per ton, will not now be contracted for under 10*l*. per ton, but I will do my best to screw them down to the lowest price. Notwithstanding the present high price, I have every reason to believe that prices will be still higher in the spring; for since I wrote to you, I have traversed the whole iron region, visiting every establishment of any importance, and every where I found an activity and bustle which I never before witnessed during my long experience in this business. Every establishment is full, to excess, of orders, and the greatest exertions are making, day and night, to execute them. The Pacha of Egypt's order for about 5,000 tons for the railway across the Isthmus of Suez, is about one-half completed; but others pour in from France, (there are two recently from that country for about 6,000 tons,) from Germany, Belgium, America, and every part of this country, in a way to astonish even the most enthusiastic friends of the railway system. Besides this demand for railway iron, the consumption of other kinds of iron fully keeps pace with it. This country being in a more prosperous condition, and every branch of trade, cotton, silk, wool, flax, hemp, tin, lead, copper, &c., being more flourishing, than at any period since the termination of the Napoleon wars; it is reasonable to suppose, and such is the fact, that iron, which is the foundation upon which the arts of civilized life rests, should be in great demand, when all other branches of industry flourish. Hence the demand for domestic consumption for ordinary purposes is very great, which, when added to the demand for foreign countries, and railway purposes, you may easily imagine will readily account for the present prices, and the prospect of still higher in the spring, unless war or some other calamity should ensue to check the brilliant progress of civilization arising from the long continuance of peace.

POTATOE BEER.

A professor of chemistry at Prague has succeeded in producing a very excellent kind of beer from potatoes, clear as wine, pleasant to the taste, and strong.

A WALKING-STICK.

A walking-stick, recently presented to Mr. Sopwith, surveyor, of this town, contains, in the dimensions of an ordinary cane, the following materials:—Two inkstands, pens, penknife, ivory folder, Lucifer-matches, sealing wax, and wafers, a wafer-stamp, wax-taper, several sheets of post letter-paper and card-paper, a complete and highly-finished set of drawing-instruments, ivory rule and scales, lead and hair pencils, Indian-rubber, Indian-ink, a thermometer, and a beautiful and well-poised magnetic compass; the whole so arranged as to admit any instrument being used with facility.—*Newcastle Paper.*

NEW CARRIAGE-WARMER.

Dr. M'Williams, of this city, has taken out a patent for a stove for heating carriages of all kinds, which is one of the most valuable inventions which has ever been made. It is remarkable in its structure, and may be sold for 6 or 8 dollars; and it consumes the most inconsiderable quantity of coal. The advantages of such a stove are almost too obvious to be mentioned. Taking up very little room, they may be fitted to the bottom of gigs or chaises, and of every variety of carriage, and are particularly well adapted to railroad-cars. The expense of fuel is not above 3 cents for 100 miles travelling, at the ordinary rate. It is only necessary to make this invention known, to secure its introduction very generally. For a trifling expense, a stage-driver may now be as comfortably situated on his box, as by the by-room fire and the pleasure of sleigh-riding may be enhanced a hundredfold. This stove is now used in the cars of the Baltimore and Washington Railroad, and gives entire satisfaction. The passengers are kept warm during the whole journey, and are never annoyed by smoke, the stove being air-tight.—*Washington Mirror.*

PLOUGH BY STEAM.

Some experiments were lately tried at Red Moss, near Bolton, in the presence of Mr. Handley, M. P. for Lincolnshire, Mr. Chapman, M. P. for Westmeath, and other gentlemen interested in agriculture, with a new and very powerful steam-plough, constructed by Mr. Heathcote, M. P. Tiverton. About 6 acres of raw moss were turned up in a few hours, in the most extraordinary style,—sods 18 inches in breadth, and 9 inches in thickness, being cut from the furrow, and completely reversed in position, the upper surface of the sod being placed exactly where the lower surface had been before. * * * The plough of Mr. Heathcote, though a very powerful machine, appears to us to be much too complex and costly for common agricultural purposes; though we have little doubt that it might be used not only with effect, but with advantage, in reclaiming large portions of moss land, such, for instance, as the bogs of Ireland. Indeed, it is the opinion of Mr. Heathcote himself, that it would not at present answer to employ it in reclaiming a smaller portion of bog than 1,500 or 2,000 acres, though it may probably be cheapened and simplified so as to make it ultimately useful on a smaller scale.—*Liverpool Paper.*

RAILROADS IN THE UNITED STATES.

It is estimated, on good authority, that at this time the railroads in the United States, either actually under contract or in progress of being surveyed, amount to more than 3000

miles. Each yard of the highest iron rails, fit for a railroad, weighs 62½lbs. As there are 1,760 yards in a mile, each mile of railroad, with a double track, will require 238 tons of rails, besides chains, screws, and bolts—amounting, in the whole, to at least 250 tons for iron per mile—250, multiplied by 3,000, is 750,000 tons of iron, that will shortly be used in the United States in the construction of railroads. Such is the demand for railroad iron in England for the American market, that common bar-iron, which one year ago was worth only 6*l*. 10*s*. sterling in Wales, is now worth 9*l*. 10*s*. at the Welsh works, as appears by the British Prices Current. It is stated in the New York papers, that at this time contracts have been actually made in England, by American houses, for 400,000 tons of railroad iron to be shipped to this country.—9*l*. 10*s*. sterling is about 45 dollars of our money; but railroad-iron costs more than common bar-iron, and is at this time worth at least 50 dollars per ton, at the works in Wales or Staffordshire. Four hundred thousand tons of iron, at 50 dollars per ton, is *twenty millions of dollars*, that the people of the United States are bound to pay to the English by their present contracts for railroad-iron. If all the projected railroads of this country shall be laid down with British iron rails, we shall pay to the English nation, within the next seven years, at least *fifty millions of dollars for railroad-iron*. And yet we have in our mountains both iron ore and coal, of the best quality, and in quantities sufficient to yield iron for the whole world.—*American Railroad Journal.*

INTRODUCTION OF BURDEN'S BOAT INTO FRANCE.

Baron Seguier, Member of the Institute, has constructed a boat after the plan of Burden's, of two double cones 100 feet long, with the engine between them, which, with the boiler, presents some improvements. M. Cave, a mechanical engineer, has also constructed a double boat, for the navigation of the canal of Somme. It differs from the preceding in being open at the surface, covered with a flooring, and has two keels and two helms. A similar boat has been constructed for the navigation of the Loire, between Nantes and Angers.—*Bul. Soc. Enc. l'Ind. Nat.*

SPECIFICATION OF THE PATENT GRANTED TO JAMES FERGUSON SAUNDERS, OF TENTERDEN STREET, HANOVER SQUARE, IN THE COUNTY OF MIDDLESEX, GENTLEMAN, FOR CERTAIN IMPROVEMENTS IN CLARIFYING RAW CANE, AND OTHER VEGETABLE AND SACCHARINE JUICES, AND IN BLEACHING SUCH RAW JUICES.—Sealed September 1, 1835.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said James Ferguson Saunders, do hereby declare the nature of the invention and the manner in which the same is to be performed, are fully described and ascertained in and by the following description thereof (that is to say) :—

The invention relates to submitting the juice of the sugar cane, and other juices containing saccharine matter, to a process hereafter described, whereby the oily, mucilaginous, and other matters prejudicial to crystallization, are separated and precipitated, previously to applying heat to such juices in the process of manufacturing sugar. According to the ordinary practice of producing sugar, particularly from cane juice, the same is, as quickly as possible, submitted to the application of heat, which, together with the admixture of alkalies, or other materials, cause the mucilaginous and other impurities to rise to the surface, in the form of scum, which is removed by the scummer. This is not only a troublesome process, and expensive, but, at the same time, is not fully effectual in clarifying the juice, and, owing to the necessary application of heat, in order to conduct this part of the process, much of the impurities or matters prejudicial to crystallization, are so embodied with the saccharine properties of the juices, that they cannot be separated the one from the other previously to crystallization, by any subsequent process; but by the invention, as communicated to me from abroad, these matters are more entirely separated previously to the application of heat, and, at the same time, the further process of bleaching such juices may be effected more advantageously than heretofore by the application of animal or other charcoal. The invention consists in mixing, in a suitable vessel, earth with raw cane, or other juices containing saccharine matter, stirring the same regularly in one direction as the earth is applied; by this means the earth and mucilaginous and oily and other matters, prejudicial to crystallization, take to each other, and, when left, will quickly subside and leave the pure or clarified juice at the top, which is to be drawn off and submitted to the ordinary process of evaporation, in order to concentrate it for crystallization. It may be here desirable to remark, that, on an extensive practical inquiry, and application of this invention, it has not been discovered that one description of earth has a materially different effect to others, but all have a like property of taking to the mucilaginous, oily, and other impurities, and precipitating them, thereby separating the same from the pure saccharine matter contained in the juice. As juices, even from the same vegetable substance, vary in quality, no definite proportions of earth can

be given : but a little attention and practice will soon enable an individual to perform the operation in process, with the fullest effect, and in order to facilitate this operation being fully understood, it should be stated that the earth is preferred to be taken sufficiently below the surface, to prevent any vegetable substance being introduced with it into the juice. The earth being first sifted, in order to remove stones, and by water is made wet, to about the consistency of thick mud ; it is to be gradually stirred into the juice, observing that when small streams of clarified juice follow the course of the stirring instrument or stick, no further earth will be required, nor will further stirring be necessary, and the quantity of earth will generally be found to be about one by measure to ten of juice. It is not desirable to continue the addition of earth during the whole time of stirring ; but, on the contrary, it is better to add the earth from time to time, watching the effect of the stirring, and judging whether a further application of earth is necessary: though the whole quantity of earth would be better if applied at once, if the operator, from experience, has obtained a knowledge of the proper quantity.

Having thus far explained the nature of the invention, I would have it understood that the result depending on a porous property or affinity which the earth has for the oily, mucilaginous, and other impurities, and its being of a greater specific gravity than the juice which causes such impurities to be precipitated with earth that clarify the juice, it will be evident that those matters having similar properties, such for instance as pulverized pumice stone, will have a like effect. I do not therefore confine myself to any particular earth or material ; though, so far as experience goes, common earth is not only the cheapest but most effective. The invention in respect of clarifying the juices, it should be understood, relates to the process of precipitating the oily, mucilaginous, and other impurities, by means of the materials described previously to the application of heat : having performed the operation of stirring and mixing, as above-mentioned, the whole is to stand quiet till the earth or other suitable material has precipitated with the impurities. The clarified juice may then be drawn off by suitable plugs or taps placed in the vessel, and it will be found that the earth and impurities will retain but a very small portion of juice, the same drawing off very freely. It now only remains to explain the manner of bleaching the juice, in conjunction with the clarifying process. This consists in introducing into the receiver, previous to the juice running into it, a quantity varying a little according to the quantity of colour contained in the juice of animal or other charcoal, having known bleaching properties reduced to fine impalpable powder, and saturated with water. This charcoal having been stirred up ten or fifteen minutes with the juice, earth must be added, as in the former process, to precipitate the whole. The approximate proportion requisite will be a quarter of a pound of animal charcoal to a gallon of juice ; of other charcoal half a pound ; using in each case a double quantity in the first instance of either charcoal will insure it being sufficient for three operations.

Having now described the nature of the invention, as communicated to me from abroad, I would have it understood that I am aware that alkaline and other earthy substances, as well also as animal and other charcoal, have been used in various ways in the manufacture of sugar ; I do not therefore lay claim to the application of the same generally, but do confine the claim of invention, secured by the present letters patent, to the process herein described for clarifying and bleaching cane and other juices by precipitation, by means of the materials herein set forth, when such process is performed previous to such juices undergoing the application of heat, as above described.—In witness whereof, &c.

Enrolled September 1, 1835.

PERSPECTIVE MADE EASY.

(*Continued from page* 243.)

10. If, in the ground plan, or the elevation, one part keeps another out of sight, the part hid must be drawn, before its perspective can be made. The dotted lines in the ground plan, showing the small moulding on the top of the pillar, and the dotted lines in the same plan, that show the round panels in the cube that is close to the picture-sheet, illustrate this remark.

11. If a picture is wanted, in which the transparent plane does not stand perpendicular, the easiest way to make it, is to consider the picture-sheet perpendicular, and draw the figures, corresponding to the ground plan and elevation, as if the objects were put off the perpendicular, by elevating one side of the horizontal surface passing through the lowest point in them.

12. Sometimes after the ground plan of any object, or number of objects, is drawn, it may be considered better not to have the picture-sheet in this plan parallel to the top or bottom edges of this drawing-board, but in a direction such as the line *b c*, in fig. 4, is drawn. When this happens, draw, as in fig. 1, lines from all the points in the ground plan to *d*, the point of sight ; then let fall

perpendicular lines from the same points to the picture-sheet, *b c*; after this, draw from a point *c*, (which is beyond the lines drawn from the place of the points in the ground plan to the picture-sheet,) the line *c e*, parallel to the top or bottom edge of the drawing-board. Then from the point *c*, where the lines *b c* and *e c* meet, with a pair of pencil bows draw circles to *e c*, from all points in *b c*, where the perpendicular lines, and the lines drawn to the eye from the points in the ground plan, meet it; also the point where a perpendicular let fall from the point *d*, to the picture-sheet meets it, must be transferred by means of the pencil bows to the line *e c*; and perpendicular to *e c*, from this last point transferred, mark off the point *f*, at the same distance from *e c*, that *d* is from *b c*. It will now be evident, that trans ferring the points *b c* to *e c*, and setting the point *f*, in the position mentioned above, produces the same effect, as if *b c*, with all the points on it, together with *d*, the point of sight, moved with the same angular motion round the point *c*, as a centre, till *b c* came to the position *e c*. The point *d* would then coincide with *f*, and *e c* would be the picture-sheet with all its points upon it, brought into a position parallel to the bottom of the drawing-board. When the operation is thus far gone through, the rest of the process is conducted, as if the ground plan had been drawn to suit the picture-sheet in the position *e c*. In order that fig. 4 may be fully understood, I need only add, that *h* is an elevation of the object *a* in the ground plan, and *k* is the perspective view of it: *g* in the perspective view being the position of the eye, or the vanishing point of the lines running perpendicular to the picture-sheet. Rather than draw a perspective view with the position of the picture-sheet in the ground plan inclined to the sides of the drawing-board, as in fig. 4, it will be better to shift the blade of the drawing square, so as to draw the ground plan of the objects at the required angle to the picture-sheet, when it is in a position as in fig. 1.

13. When a figure in the objects to be represented is parallel to the transparent plane theperspective of the figures is similar to the original one, but less in magnitude according to its distance. J. W.

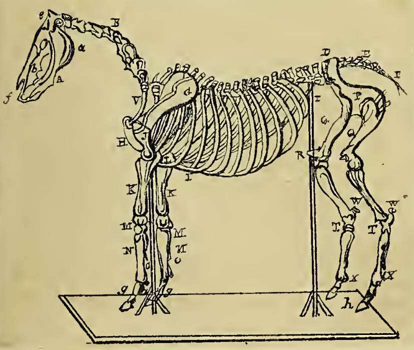
THE

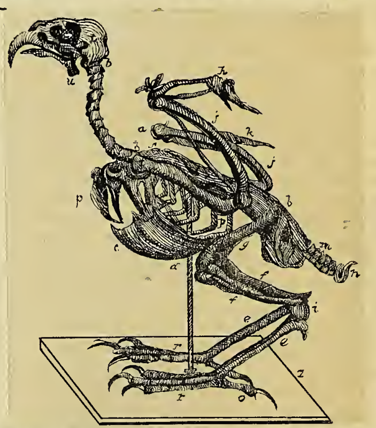
STUDY OF SCIENCE,

A FAMILIAR INTRODUCTION TO THE PRINCIPLES OF NATURAL PHILOSOPHY.

As, among our readers, there may be some who have not had opportunities of becoming acquainted with the recent elaborate researches and ingenious speculations of learned men in the several departments of Natural Philosophy, we have determined to devote a certain number of pages monthly, to form a series of lectures in the several branches of science, by way of a familiar introduction to the study of Natural Philosophy with modern discoveries.

THE TAXIDERMIST; OR THE ART OF COLLECTING, PREPARING, AND PRESERVING OBJECTS OF NATURAL HISTORY.





The advantages to be derived from a collection of objects of Natural History, are too apparent to require any illustration; and their beauty and variety of their forms have, in a preserved state, ever attracted the admiration of mankind, as being next in point of interest to the living animals. Although

good drawings and engravings will give us a perfect knowledge of the general appearance of animals, still they are deficient in many particulars; for by them we cannot be made acquainted with the texture of the skin, nor the structure of the hair or feathers.

The naturalist, on all occasions, prefers a reference to the stuffed animal to that of a pictorial representation, as by this means he is enabled to trace, compare, and decide, on the creature in its several characters and relations.

In museums and cabinets are brought together natural objects of all kinds, from the most extreme points of the globe; and presented in a form that enables us, as it were, to look upon the mighty field of nature at one view; with the additional advantage of having the various Classes and Genera placed in systematic order, to investigate which, in their native wilds, would be the business of several lifetimes. Besides, we can here contemplate, without dread, the most destructive and furious quadrupeds, and the most noxious reptiles. Here we can muse upon and study the animals which have created in us the highest of sentiments while reading the tale of the traveller, or the singularity of organization, pointed out by the naturalist.

He who has attended to any branch of Natural History, will best know how difficult it is to collect even the animals, plants, or minerals of Britain; because some of the individuals are extremely local in their habitats.

To instruct in the manner of Collecting, Cleaning, Preparing, and Preserving these, is the object of the following Treatise. This art has been practised in a certain degree from very early times, but it was not till after the middle of the last century, that *Taxidermy*, or the art of preserving objects of Natural History, had reached any degree of perfection, and it is still susceptible of much improvement.

We have seen that attempts at the preservation of animal substances were practised by the Egyptians in the instance of Mummies and the Ibis, which they always preserved along with their chiefs. But these were prepared in such a manner as to produce no pleasurable sensations in examining them; being remarkable only for their great antiquity.

It is to be lamented, that even to the present day chemists have not discovered means of effectually resisting the universal law of decay, which, by certain fixed operations, reduces every kind of organised matter to its original elements. Methods have been devised of arresting for a time the progress of decay, but these seem gradually to lose their effect, and ultimately become mutilated and decomposed. Animal substances are subject to the ravages of thousands of minute animals. This is probably brought about by the varied changes and penetrating powers of the atmosphere, caused by its gases, heat, and moisture. We do not mean by this that the atmosphere creates minute beings, only its influence is favourable and indispensable to their reproduction. On unorganised substances, these are found to be ever acting and destructive agents.

To devise the means of preventing these effects is the business of the Taxidermist, and upon his success the excellence of his art will depend. It will, therefore, easily be imagined how important and indeed indispensable to his art is a thorough knowledge of chemical science, for by experimenting on preservatives on established chemical principles, he may discover the best method of averting the progress of Time's destroying hand.

Although considerable advances have been made of late years in the art of Taxidermy, it is still far from perfection. This is to be attributed, in a great measure, to the education of the persons who practise this art; for among all I have met with employed in the presevation of animals, none have had the advantage of anatomical study, which is quite indispensable to the perfection of stuffing. One or two individuals, it is true, have attended to the structure of the skeleton of Man, and a few of the more common animals, but this is far from the information which they ought to possess; for nothing short of a general and extensive knowledge of comparative anatomy can qualify them sufficiently for an art which is so comprehensive and varied in its application.

These observations are particularly applicable to Quadrupeds and Reptiles; for what are even the best stuffed specimens of the first museums in the world compared to the living subject? Nothing better than deformed and glaringly artificial productions, devoid of all the grace and beautifully turned points of living nature. A knowledge of drawing and modelling are also indispensable qualifications, to enable the stuffer to place his subject in a position both natural and striking. It is the too frequent practice for the stuffer to set about preserving the animal without having determined in what attitude he is to place it, so that it will appear to most advantage, and be in character with the ordinary habits of the creature. This he leaves to the last efforts of finishing his work, and, consequently, its proportions and character are likely to be devoid of all appearance of animation.

The first thing, therefore, to be attended to in all great national natural history establishments, is to choose young persons who are yet in their boyhood, to be instructed in this art, most important to science. Their studies should be commenced by deep attention to drawing, modelling, anatomy, and chemistry, while they, at the same time, proceed with the practical part of their art. Every opportunity of examining the habits and actions of the living subject should be embraced, and its attitudes and general aspect carefully noted. Without strict attention to these points, so manifestly obvious, the art of preserving animals *never will* attain that degree of perfection which its importance demands. On the other hand, if this art is pursued in the manner here recommended, artists may be produced who will fulfil the ob-

jects of their profession with honour to themselves and advantage to their country. Would any person expect to arrive at eminence as a sculptor if he were unacquainted with the established preliminaries of his art, namely, drawing and anatomy? The thing is so self-evident, that I am only surprised it has not long ago been acted upon. Upwards of twelve years have elapsed since I pointed out these facts to the Professor of Natural History in the University of Edinburgh, but things continue as they were before that time.

Although these observations apply with their full force to the preservation of the Mammalia, or Quadrupeds, they are equally applicable to Birds and Fishes. It is quite true, that defects in ill-stuffed birds are not so obvious as in quadrupeds, because the feathers assist in a great measure to conceal such deformities; and in fishes, imperfections are also less observable, owing to the smooth and unmarked appearance of their external surface, from the circumstance of their bones being principally small towards their outside, and the larger bones being deeply concealed under the muscles.

I am happy to find that the ingenious Mr. Waterton agrees with me on this important subject. "Were you," says he, "to pay as much attention to birds as the sculptor does to the human frame, you would immediately see, on entering a museum, that the specimens are not well done.

"This remark will not be thought severe, when you reflect, that that which was once alive, has probably been stretched, stuffed, stiffened, and wired, by the hand of a common clown. Consider, likewise, how the plumage must have been disordered by too much stretching or drying, and, perhaps, sullied, or at least deranged, by the pressure of a coarse and heavy hand,—plumage which, ere life had fled within it, was accustomed to be touched by nothing rougher than the dew of heaven, and the pure and gentle breath of air.

"In dissecting, three things are necessary to insure success, viz., a penknife, a hand not coarse or clumsy, and practice. The first will furnish you with the means, and the second will enable you to dissect, and the third will cause you to dissect well. These may be called the mere mechanical requisites.

"In stuffing you require cotton, a needle and thread, a little stick the size of a common knitting needle, glass-eyes, a solution of corrosive sublimate, and any kind of a common temporary box to hold the specimen. These also may go under the denomination of the former. But if you wish to excel in the art, if you wish to be in Ornithology, what Angelo was in sculpture, you must apply to profound study and your own genius to assist you. And these may be called the scientific requisites.

"You must have a complete knowledge of Ornithological anatomy. You must pay close attention to the form and attitude of the bird, and know exactly the proportion each curve or extension, or contraction, or expansion of any particular part bears to the rest of the body. In a word, you must possess Promethean boldness, and bring down fire and animation as it were into your preserved specimen.

"Repair to the haunts of birds on plains and mountains, forests, swamps, and lakes, and give up your time to examine the economy of the different orders of birds.

"Then you will place your Eagle, in attitude commanding, the same as Nelson stood in, in the day of battle, on the Victory's quarter deck. Your Pie will seem crafty, and just ready to take flight, as though fearful of being surprised in some mischievous plunder. Your Sparrow will retain its wonted pertness, by means of placing his tail a little elevated, and giving a moderate arch to the neck. Your Vulture will show his sluggish habits by having his body nearly parallel to the earth; his wings somewhat drooping, and their extremities under the tail instead of above it,—expressive of ignoble indolence.

"Your Dove will be in airless, fearless innocence, looking mildly at you, with its neck not too much stretched, as if uneasy in its situation, or drawn too close into the shoulders, like one wishing to avoid discovery; but in moderate, perpendicular lengths, supporting the head horizontally, which will set off the breast to the best advantage."*

To the traveller who wanders in search of knowledge, but without the means of conveying skins of quadrupeds or birds, we would say a word or two. When he has killed and examined an animal or bird, which appears new to him, after having noted down all its characters, he ought to attempt a drawing of the object, as the next best substitute for the skin.

The indefatigable Wilson, whose unbounded zeal led him to explore the mighty wilds of America, in search of information regarding the feathered tribes, but who, without either money or patronage, could not transport their skins across these nearly boundless wildernesses, was compelled to adopt these, the only means he had, and to delineate their forms and features, in their native colours, as faithfully as he could, as records at least of their existence.

Audubon adopted this method. He pinned the bird to a tree in some natural position, held out by wires, &c., then made a drawing while the animal was yet warm. By this means he could imitate those beautiful tints which are alone to be found in living nature; and the forms being still those of the real subject, were likely to surpass those of stuffed specimens.

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* Wanderings in South America, &c. by Charles Waterton, Esq., a work that cannot be too highly commended, from the many remarkable incidents contained in it, and the highly poetic and zealous warmth of its diction.

OF SKINNING, PREPARING, AND MOUNTING THE MAMMALIA, OR QUADRUPEDS.

OF SKINNING.

When a quadruped is killed, and its skin intended for stuffing, the preparatory steps are to lay the animal on its back, and plug up its nostrils, mouth, and any wounds it may have received, with cotton or tow, to prevent the blood from disfiguring the skin. A longitudinal incision is then made in the lower part of the belly, in front of the pubis, and extended from thence to the stomach, or higher if necessary, keeping in as straight a line as possible, and taking care not to penetrate so deep as to cut into the abdominal muscles. In some instances, the incision is made as high as the collar bone. In this operation the hairs must be carefully separated to the right and left, and none of them cut, if possible. The skin is also turned back to the right and left, putting pads of cotton or tow between it and the muscles, as the skinning is proceeded with. If any fatty or oily substance should be noticed, it must be carefully wiped away. The skin being removed as far in every direction as the extent of the incision will admit of, each of the thighs must be separated at its junction with the pelvis, that is, by the head or ball of the *Os femoris*,* or thigh bone. The intestinal canal is then cut across, a little way above the anus, and then the tail is separated, as close to the animal as possible. After this the pelvis is pulled out of the skin, and the skin separated from the back by inserting the handle of the scalpel cutting-knife between it and the carcase. It is pulled gradually upwards until the operator reaches the shoulders. The whole hinder parts and trunk of the body being thus out of the skin, the next operation is to remove the fore-legs, by separating them from the body at the shoulder-joint, or the base of the *Os humeri*. When the joint of one shoulder has been separated from the body, the leg is again put into the skin, and the animal then turned in order to repeat the same with the other side, the limb of which is also returned. The skin is then removed from the neck. The next thing is to separate the skin from the head by the assistance of the scalpel. It is taken off as far as the point of the nose; while great care must be taken not to injure the eyelids, and to cut the ears as close to the skull as possible; and also to avoid cutting the lips too close.

All this having been performed, the head and trunk of the animal are completely separated from the skin. The next operation is to remove the head of the animal from the trunk, at the upper bone of the vertebræ. The external muscles of the head and face are then carefully cut off with a scalpel, and the bones left as free from flesh as possible. The occipital bones are next enlarged by means of a strong knife, or other instrument; and the brain all carefully removed. The fore legs are now pulled out of the skin, by drawing the legs one way, and the skin another, as far as the claws of the foot. All the muscles are then cut off the bones, while care is taken not to injure the ligaments and tendons. They should be left adhering to the knee. They are then returned into the skin again. The hind legs are treated in the same manner. The tail is the last part which is skinned, and this is a more difficult task than the other parts of the body. Two or three of the first joints or vertebræ are first laid bare by pulling the skin back; they are then tied firmly with a strong cord, which must be attached to a strong nail or hook on the wall. A cleft stick is introduced between the vertebræ and the skin, the stick is then forced to the extremity, and the tail-bones come out of their enveloping skin or sheath.

The skeleton head, having been divested of all its fleshy matter, tongue, palate, external muscle, and brain, is now returned to its place in the skin, which is in a condition for commencing the operation of stuffing.—*Brown.*

* Those who are unacquainted with the names of the different bones of the skeleton, will find a full detail of those of both Quadrupeds and Birds in our description of Plate I.

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. exhibits the skeleton of the *Falco Palumbarius*, or Goshawk, and shows the manner in which it is supported by a small iron rod; and also the names of the bones.

a. Ball of the Ulna.
b, b, b. The vertebræ of the neck, or cervical vertebra.
c, d. The Sternum.
e, e. The Tarsus.
f, f.—The Fibula.
g. The Tibia.
h. h.—The metacarpal bones.
i, j. The Ulna.
m.—The Pelvis.
n.—The Os Coccygis.
q. The Clavicle.
s.—Vertebræ of the back.
t. The Os Humeri.

Fig 2. Skeleton of a Horse, showing the manner in which it is supported; and also the names of the bones.

A. The head.
a.—The posterior maxillary or jaw bone.
b. The superior maxillary, or upper jaw.
c. The orbit of the eye.
d. The nasal bones, or bones of the nose.
e. The suture, dividing the parietal bones below from the occipital bones above.
f.—The inferior maxillary bone, containing the upper incisors, or cutting teeth.
B. The seven Cervical Vertebræ, or bones of the neck.
C. The eighteen Dorsal Vertebræ, or bones of the back.
D. The six Lumbar Vertebræ, or bones of the loins.
E.—The five Sacral Vertebræ, or bones of the haunch.
F.—The Caudal Vertebræ, or bones of the tail, the usual number being fifteen; sometimes, however, they vary.
G.—The Scapula, or shoulder blade.

H. The Sternum, fore part of the chest or breast-bone.
I. The Costæ, or ribs, seven or eight of which articulating with the Sternum, are called the *true ribs*, and the remaining ten, or eleven, which are united together by cartilage, are called the *false ribs*.
J.- The Humerus, or bone of the arm.
K. The Radius, or bone of the fore arm.
L. The Ulna, or elbow, with its process, the olecranon.
M, M. The Carpus, or knee, consisting of seven bones.
N, N. The Metacarpal, or shank bones. The large Metacarpal, or cannon, or shank in front; and the smaller Metacarpal, or splent bone behind.
g. The fore pastern and foot, consisting of the Os Suffraginis, or the upper and longer pastern bone, with the sesamoid bones behind, articulating with the cannon and greater pastern; the Os Coronæ, or lesser pastern; the Os Pedis, or coffin bone; and the Os Naviculæ, or navicular shuttle bone, not seen, and articulating with the smaller pastern and coffin bones.
h.- The corresponding bones of the hind feet.
O, O.- The small metacarpal, or splent-bones.
P.- The pelvis; or haunch, consisting of three portions, the ilium, the ischium, and the pubis.
Q.-The femur, or thigh-bones.
R, R.—The patella placed on the stifle joint.
S, S.- The tibia and fibula; the latter is a small bone behind. These are also called the ham bones.
T, T.- The bones of the tarsus, or hock, six in number.
U, U. The metatarsals of the hind leg, called shank, or cannon bones.
W, W.—The os calcis, or point of the hock.
X, X, X, X. - The sesamoid, or fetlock bones.

OF THE UNIVERSE.

Of Attraction—Repulsion—Elements—Heat—Air.

(Compiled from the Works of Buffon, Goldsmith, Cuvier, &c.)

The known powers of nature may be reduced to two primitive forces, *attraction* and *repulsion*. The first is the cause of gravity; in other words, it is by the attraction which exists between the mass of earth, and all bodies near its surface, that every thing has a natural tendency downward, that all matters fall to the ground, &c. The second principle is the cause of elasticity, and by counteracting the effects of attraction, prevents the matter of the universe from becoming a solid mass.

The most ancient authors have agreed in supposing, and mankind in general still imagine, that there are only four distinct species of elementary or original matter, viz. fire, air, water, and earth. Modern science has however discovered that none of these are entitled to be considered as elements, or primary substances; while, on the other hand, it has increased the number of elementary principles to fifty two. But as the popular arrangement is sufficient for our present purpose, we will not depart from it.

There is reason to believe that fire, heat, or caloric, is the only permanently elastic substance in nature. We see that when it penetrates the pores of any body it uniformly expands it. A bar of iron is lengthened by being heated, metals and other substances are melted by it, and water is converted into vapour. There is therefore ample ground for believing that all fluidity is the effect of heat. The natural state of water is ice; and air itself, were there any means of producing a sufficient degree of cold, might probably be reduced to a solid mass.

As all fluidity has heat for its cause, we find, by comparing certain substances together, that much more heat is requisite to keep iron in fusion than gold, much more to keep gold in that state than tin, much less to keep wax, much less to keep water, much less for spirit of wine, and at last exceedingly less for mercury (quicksilver), since it only becomes solid at 187 degrees below that point at which water freezes; this matter, mercury, would be therefore the most fluid of all bodies, if air were not still more so. Now, what does this fluidity, greater in air than in any other matter, indicate? It appears to indicate the least degree of adherence that can be conceived between its constituting parts, by supposing them of such a figure as only to touch each other at one point. The greater or less degree of fluidity does not, however, indicate that the parts of the fluid are more or less weighty, but only that their adherence is so much the less, their union so much the less intimate, and their separation so much the easier. If a thousand degrees of heat are required to keep water fluid, it perhaps will only require one to preserve the fluidity of air.

It is doubtful whether light consists of the same matter with elementary fire or not. The great source of light is found to be the sun, from whose body it is projected in the space of nearly eight minutes; and as the sun is computed to be distant ninety-five millions of miles, the light must of consequence travel at the rate of about two hundred thousand miles in one second of time.

Light may be reflected as well as projected. The light which we receive from the moon is only reflected as from a mirror. The light of the sun is three hundred thousand times stronger than the light of the moon. Whether the solar rays themselves evolve the caloric of bodies or act by conveying heat, has not yet been determined.

The air we inhale is composed of 21 of oxygen to 79 of nitrogen gas, which are mixed with vapour and small quantities of other gases.

It is vulgarly supposed that flame is the hottest part of fire; yet nothing is worse founded than this opinion; for the contrary may be demonstrated by the easiest and most familiar experiments. Offer to straw fire, or even to the flame of a lighted faggot, a cloth to dry or heat, double and treble the time will be required to give it the degree of dryness or heat that would be given to it by exposing it to a brazier without flame, or even to a very small heat. Flame has been characterised by Newton as a burning smoke; and this smoke, or vapour, which burns, has never the same

quantity, the same intensity of heat, as the combustible body from which it escapes. Only by being carried upwards, and extending itself, it has the property of communicating fire, and of carrying it further than the heat of the brazier does, which alone might not be sufficient to communicate it when even very near. This idea, though partially true, has been proved by experiment to be subject to several contradictions. The flame of a spirit-lamp will render an iron wire white-hot, nor is it even in this state of so fierce a temperature as the source from whence its heat was obtained.

The effects of heat in producing a noxious quality in the air, are well known. Those torrid regions under the line are always unwholesome. At Senegal, the natives consider forty as a very advanced time of life, and generally die of old age at fifty. At Carthagena, in America, where the heat of the hottest day ever known in Europe is continual; where, during their winter season, these dreadful heats are united with a continual succession of thunder, rain, and tempests, arising from their intenseness, the wan and livid complexions of the inhabitants might make strangers suspect that they were just recovered from some dreadful distemper: the actions of the natives are conformable to their colour and in all their motions there is somewhat relaxed and languid; the heat of the climate even affects their speech, which is soft and slow, and their words generally broken. Travellers from Europe retain their strength and ruddy colour in that climate, possibly for three or four months, but afterwards suffer such decays in both, that they are no longer to be distinguished from the inhabitants by their complexion. However, this languid and spiritless existence is frequently drawled on sometimes even to eighty. Young persons are generally most affected by the heat of the climate, which spares the more aged; but all, upon their arrival on the coasts, are subject to the same train of fatal disorders. Few nations have experienced the mortality of these coasts so much as our own: in our unsuccessful attack upon Carthagena, more than three parts of our army were destroyed by the climate alone; and those that returned from that fatal expedition found their former vigour irretrievably gone. In our more fortunate expedition, which gave us the Havannah, we had little reason to boast of our success; instead of a third, not a fifth part of the army were left survivors of their victory, the climate being an enemy that even heroes cannot conquer.

The distempers that thus proceed from the cruel malignity of those climates are many: that, for instance, called the Chapotonadas carries off a multitude of people, and extremely thins the crews of European ships, whom gain tempts into those inhospitable regions. The nature of this distemper is but little known, being caused in some persons by cold, in others by indigestion. But its effects are far from being obscure; it is generally fatal in three or four days: upon its seizing the patient it brings on what is there called the black vomit, which is the sad symptom after which none are ever found to recover. Some, when the vomit attacks them, are seized with a delirium that, were they not tied down they would tear themselves to pieces, and thus expire in the midst of this furious paroxysm. This disorder, in milder climates, takes the name of the bilious fever, and is attended with gentler symptoms, but very dangerous in all.

There are many other disorders incident to the human body that seem the offspring of heat: but to mention no other, that very lassitude, which prevails in all the tropical climates, may be considered as a disease. The inhabitants of India, says a modern philosopher, sustain an unceasing languor from the heats of their climate, and are torpid in the midst of profusion. For this reason, the Great Disposer of nature has clothed their country with trees of an amazing height, whose shade might defend them from the beams of the sun, and whose continual freshness might, in some measure, temperate their fierceness. From these shades, therefore, the air receives refreshing moisture, and animals a cooling protection. The whole race of savage animals retire, in the midst of the day, to the very centre of the forest, not so much to avoid their enemy, man, as to find a defence against the raging heats of the season. This advantage, which arises from shade in torrid climates, may probably afford a solution for that extraordinary circumstance related by Boyle, which he imputes to a different cause. In the island of Ternate, belonging to the Dutch, a place that had been long celebrated for its beauty and healthfulness, the clove trees grew in such plenty that they in some measure lessened their own value: for this reason the Dutch resolved to cut down the forests, and thus to raise the price of the commodity; but they soon had reason to repent of their avarice; for such a change ensued by cutting down the trees, that the whole island, from being healthy and delightful, having lost its charming shades, became extremely sickly, and has actually continued so to this day. Boerhaave considered heat so prejudicial to health, that he was never seen to go near a fire.

An opposite set of calamities are the consequence in climates where the air is condensed by cold. In such places all that train of distempers which are known to arise from obstructed perspiration, are very common—eruptions, boils, scurvy, and a loathsome leprosy, that covers the whole body with a scurf and white putrid ulcers. These disorders also are infectious; and while they thus banish the patient from society, they generally accompany him to the grave. The men of those climates seldom attain to the age of fifty; but the women, who do not lead such laborious lives, are found to live longer.

One of the first things that our senses inform us of is, that although the air is too fine for our sight it is very obvious to our touch. Although we cannot see the wind contained in a bladder, we can very readily feel its re-

sistance; and though the hurricane may want colour, we often fatally experience that it does not want force. We have equal experience of the air's spring or elasticity; the bladder, when pressed, returns again, upon the pressure being taken away; a bottle, when filled, often bursts, from the spring of air which is included.

So far the slightest experience reaches; but, by carrying experiment a little further, we learn that air also is heavy; a round glass vessel being emptied of its air, and accurately weighed, has been found lighter than when it was weighed with the air in it. Upon computing the superior weight of the full vessel, a cubic foot of air is found to weigh 527 grains, while the same quantity of hydrogen weighs no more than 40 grains.

From this experiment, therefore, we learn, that the earth, and all things upon its surface, are every way covered with a ponderous fluid, which, rising very high over our heads, must be proportionally heavy. For instance, as in the sea a man at the depth of twenty feet sustains a greater weight of water than a man at the depth of but ten feet, so will a man at the bottom of a valley have a greater weight of air over him than a man on the top of a mountain.

If by any means we contrive to take away the pressure of the air from any one part of our bodies, we are soon made sensible of the weight upon the other parts. Thus, if we clap our hand upon the mouth of a vessel from whence the air has been taken away, there will be air on one side and none on the other; upon which we shall instantly feel as if the hand were violently sucked inwards, which is nothing more than the weight of the air upon the back of the hand that forces it into the space which is empty below.

As by this experiment we perceive that the air presses with great weight upon every thing on the surface of the earth, so by other experiments we learn the exact weight with which it presses. First, if the air be exhausted out of any vessel, and this vessel be set with the mouth downwards in water, the water will rise up into the empty space, and fill the inverted glass—for the external air will, in this case, press up the water where there is no weight to resist, as one part of a bed being pressed makes the other parts that have no weight upon them rise. In this case, as we said, the water being pressed without, will rise in the glass, and would continue to rise thirty-two feet high. From this therefore we learn, that the weight of the air which presses up the water is equal to a pillar or column of water which is thirty-two feet high, as it is just able to raise such a column, and no more. In other words, the surface of the earth is everywhere covered with a weight of air, which is equivalent to a covering of thirty-two feet deep of water, or to a weight of twenty-nine inches and a half of quicksilver, which is known to be just as heavy as the former.

It is easily found, by computation, that to raise water thirty-two feet will require a weight of fifteen pounds upon every square inch. Now, if we are fond of computations, we have only to calculate how many square inches are in the surface of an ordinary human body, and allowing every inch to sustain fifteen pounds, we may amaze ourselves at the weight of air we sustain. It has been computed, and found, that our ordinary load of air amounts to within a little of forty thousand pounds!

The elasticity of the air is one of its most amazing properties, and to which it should seem nothing can set bounds. A body of air, that may be contained in a nut shell, may easily, with heat, be dilated into a sphere of unknown dimensions. On the contrary, the air contained in a house may be compressed into a cavity not larger than the eye of a needle. In short, no bounds can be set to its confinement or expansion, at least experiment has hitherto found its attempts indefinite. In every situation it retains its elasticity, and the more closely we compress it, the more strongly does it resist the pressure. If to the increasing the elasticity on one side by compression, we increase it on the other side by heat, the force of both soon becomes irresistible; and Monsieur Amontons supposed that air, thus confined and expanding was sufficient for the explosion of a world.

ON THE ADAPTATION OF EXTERNAL NATURE TO THE PHYSICAL CONDITION OF MAN.

When Hamlet, in contemplating the grandeur of creation, breaks forth into that sublime apostrophe on man: "How noble in reason! how infinite in faculties! in form and moving, how express and admirable! in action, how like an angel! in apprehension, how like a God! the beauty of the world! the paragon of animals!" who does not feel elated by the description? who does not feel conscious of its truth?

Nor is its truth the less admissible, because the poet, in concentrating the powers of his imagination on the excellences of that work of creation which bears the stamp of the Creator's image, has omitted to present to our view the reverse of the impression, the frailty namely of our fallen nature; for although, on moral and religious consideration, each individual is bound habitually to take the one view in conjunction with the other; in a simply philosophical contemplation of human nature, we are not precluded by any reasonable barrier, from taking such a partial view of the subject as the occasion may suggest.

In the present instance, indeed, I am strictly called upon to consider, not the moral, but *the physical condition of man:*

and to examine how far *the state of external nature is adapted* to that condition; whether we regard the provisions made for *the supply of man's wants either natural or acquired;* or those which are made for *the exercise of his intellectual faculties.* The following treatise naturally, therefore, divides itself into two parts; in the first of which it is intended to investigate and describe the physical condition of man; in the second, the adaptation of external nature to that condition.

But a wide field here opens to our view: for man cannot, under any circumstances, be considered as an insulated being; or unconnected with the rest of animated nature. He is indeed but one link in the great chain of animal creation; and not only does the contemplation of his condition lose half its interest, if separated from the contemplation of the condition of other animals; but it cannot be satisfactorily investigated without that aid. And, again, animal life itself is but one among many modes of existence, by which the Creator has manifested his omnipotence, and which it is necessary to contemplate in connexion with the general phenomena of nature, in order to show the superiority of that province, at the head of which human beings have been placed.

In attempting, however, to form a just estimate of the physical condition of man, we must not regard him merely under the aspect of savage or uncivilized life, and consider this as his natural state: for it may be presumed that, at the present day, such a puerile view of the question is not for a moment entertained by any one capable of philosophical reflection. In fact, in as many different states as man does actually exist, civilized or savage, so many are his natural states. If any indeed could be pre-eminently called his natural state, it would be that of civilization: for not only does experience show that his natural tendency is towards such a state; but we know, from the highest authority, that the existence of man is connected with a moral end; (with more indeed than a moral end; since morals have immediately a relation to this life only, while man is destined for a future;) and a moral end is hardly attainable in an uncivilized state of society.

THE GENERAL CONSTITUTION OF EXTERNAL NATURE.

The more familiar objects of that external world by which man is surrounded are usually distributed into three kingdoms, as they are called; the *animal*, *vegetable*, and *mineral:* but for the purpose of this treatise it will be necessary to take into our account the phenomena of the *atmosphere* also.

The *atmosphere* principally consists of the *air* which we respire: (a form of matter so subtle, in all its states, as to be invisible;) together with a variable proportion of *water*, of which a part is always retained in close combination with the air; and, like the air itself, exists always in an invisible state. There are also diffused through the atmosphere those still more subtle agents, *heat* and *electricity*. But all these, though of so subtle a substance, are in their occasional effects the most powerful agents of nature. For, omitting the consideration of their silent but wonderful operation, as exhibited in the process of vegetation, and in many other processes less open to observation, let us consider the occasional effects of air in the violence of a tornado; or of water, in the inundation of a rapid river: or let us contemplate the effect of either an indefinite diminution or increase of heat; on the one hand, the natural process of animal decomposition arrested by its abstraction, so that the imbedded mammoth remains at this moment in the same state that it was four thousand years ago; and in which, under the same circumstances, it undoubtedly would be, four thousand or four millions years hence; on the other hand, the possibility of the dissipation of all the constituent parts of matter, or their fixation in the state of glass, resulting from the agency of indefinitely increased heat: or, lastly, let us consider the tremendous effects of condensed electricity in the form of lightning:—and we shall necessarily acknowledge that though in their usual state the constituents of the atmosphere are among the most tranquil agents of nature, yet, when their power is concentrated, they are the most awfully energetic.

In the *mineral kingdom* the most characteristic property of the several species appears to be a disposition to a peculiar mode of mutual attraction among the particles composing the individuals belonging to them; from which attraction, when exerted under the most favourable circumstances, result that symmetry and regularity of form, to which the term *crystal* has been applied. The transparency and degree of hardness of crystals are various, and depend much upon external circumstances. The form is fundamentally the same for each species, though capable of being modified according to known laws; and the substance is chemically the same throughout its whole extent. Every atom of a crystallized mass of gypsum consists of water, lime, and sulphuric acid, united in the same proportions as are found to exist in the whole mass, or in any given part of it.

The individuals of the *vegetable kingdom* differ very remarkably from those of the

mineral, both in form and substance. In their form we see nothing like the mathematical precision of crystallization; and in their substance they differ widely, according to the part of the vegetable which is examined; so that, independently of previous knowledge of the species, we could hardly discover any natural relation between the several constituent parts of the individual. What is there in the insulated leaf of a rose or of a peach tree, that would lead us to expect the fruit of the one or the flower of the other? But the most remarkable line of distinction between vegetables and the individuals of the preceding kingdom consists in their mode of increase and reproduction. Minerals can only increase, as such, by apposition of particles specifically similar to themselves; and can only be originally produced by the immediate combination of their constituent elements. But vegetables have an apparatus within them, by means of which they can assimilate the heterogeneous particles of the surrounding soil to their own nature; and they have also the power of producing individuals specifically the same as themselves: in common language, they are capable of contributing to their own growth, and to the continuation of their species. And as they produce these effects by means of internal organs adapted to the purpose, they are hence denominated organized bodies.

The individuals of the *animal kingdom* very closely resemble those of the vegetable in the two properties just described. The respective organs differ, as we might expect, in their form and position: but in their functions or mode of action, there is a strong analogy, and even similarity, throughout. But animals differ from vegetables more remarkably than these do from every unorganized form of matter, in being endued with sensation and volition; properties which extend the sphere of their relations to such a degree, as to raise them immeasurably above all other forms of matter in the scale of existence.

In distributing the individuals of the material world among these four kingdoms of nature, there occasionally prevails considerable obscurity, not only with respect to the true place which an individual ought to occupy in the scale of a particular kingdom; but even with respect to the question, under which of the four kingdoms it ought to be arranged; this obscurity arising of course from the points of resemblance apparently balancing, or more than balancing, the points of difference. Let us, for instance, in the atmospherical kingdom, take a fragment of a perfectly transparent crystal of pure ice; and, under ordinary circumstances, it would be difficult, either by the sight or the touch, to distinguish it from a fragment of transparent quartz, or rock crystal: indeed the transfer of the original term *krustallos* from the one to the other, shows the close resemblance of the two. Some minerals again so nearly resemble vegetables in form, as to have given rise to specific terms of appellation, derived from the vegetable kingdom; as *flos ferri*, *mineral agaric*, &c. And, lastly, many of the animals called sea-anemones so far resemble the flower called by the same name, that their real character is at first very doubtful to those who are unacquainted with the animals of that genus. But, omitting these rare and equivocal instances, and avoiding the confinement of abstract definitions, we may safely affirm that, of all the kingdoms of nature, the individuals of the animal kingdom have the most extensive and important relations to the surrounding universe. And I need not here insist on the obvious inference, that if among the kingdoms of nature animals hold the first rank, in consequence of the importance of these relations, among animals themselves the first rank must be assigned to man.—*Kidd.*

THE SPIRIT OF THE INDIAN PRESS,

OR MONTHLY REGISTER OF USEFUL INVENTIONS, AND IMPROVEMENTS, DISCOVERIES, AND NEW FACTS IN EVERY DEPARTMENT OF SCIENCE.

PLANTING AND MODE OF REMOVING SUGAR CANE FROM ONE SPOT OF INDIA TO ANOTHER.

It appears that Captain Sleeman has a sugar plantation at Jubbulpore in Central India; and, with a zeal, liberality, and spirit, highly creditable to him, has offered to supply the plant gratis to all applicants.* The following is his description of

* Application to be made to Captain Reynolds, or Lieut. C. Brown, Jubbulpore.

the period for planting the cane and mode of conveying from one spot to another. We take the account from another ably conducted Mofussil paper—the Delhi Gazette.

The canes may be planted at any time during the months of December, January, or February, and they will ripen in November, December, and January of the following season.

The canes may be safely taken entire on wheeled carriages to any distance which such conveyance can travel in a month. To any greater distance they had better be taken either on camels, or cut up and planted in boxes. If on camels, they are packed up entire in straw, which is kept moist on the road, while the camels should be required to travel by long stages. Or a cane is put entire into the split trunk of a plantain tree, the pith of which will afford it sufficient moisture. All these modes of sending the canes are well understood at the plantation, and will be explained to the people who are sent for the cane.

If cut up and planted in boxes, the cuttings contain each five or six joints, and are inserted into the earth diagonally, so that the upper ends of the cuttings may be above the earth, while the lower ends are about a foot below the surface. Three or four of these cuttings are inserted at each end of the box, so that they cross each other in the earth. The earth must be kept moist, but not wet, during the journey; and an awning should be used to defend them from the sun, but not so close as to keep the air from the plants, or to rub against the ends that rise to the top of, or above the top of, the boxes. The best soil is what the natives call *Doomuteea:* and the best manure is cow-dung. Tight clay or very moist soils are bad; though the cane may thrive in them, the juice will never be of good quality.

The soil should be prepared for the reception of the cane in the rains: but, for these experiments, every person has a small patch of land in his garden, sufficiently prepared for the purpose at any time. The canes should be planted in cuttings of three or four joints each, and so placed that the upper end may be at or near the surface, and the lower end some six inches, or more below it; and that the shoots may be at the sides, and not up and down. The holes, in which the cuttings are planted, should be about a foot wide, and two feet long; and they should be in rows four feet asunder. In each row the holes should run lengthwise, and be two feet separate from each other at the ends. After the ground has been manured in the usual manner all over the space to be planted, it will be well to have a little manure put into each hole and mixed up with the earth, to form a rich bed for the canes to lie upon. In each hole there should be four cuttings (two from each end), which cross each other under the earth as above described for the boxes.

The canes should be watered every eight days, as well to secure them against white ants and other insects as to nourish them, but to water them oftener is, I believe, injurious. The water must be made to run along between the rows, so that it may irrigate the canes without lying upon them in pools; and consequently the ground between the rows must, from the first, be a very little lower than that upon the canes, and between the ends of the several holes. During the season of the rains the ground must be frequently weeded, and kept very clean, so that nothing may lie about the roots, or impede the free circulation of air. Any lateral shoots must be removed from the canes as soon as they are discovered; but the leaves should be left untouched, unless they are dead and rotting.

I have found *rats* to be great depredators on the cane plantation, and the most effectual mode of keeping them out, that I have found, was taught to me by a native planter. It is strewing along between the rows of cane some of the leafless branches of a kind of cork tree, which the natives, I believe, call *Hulsee*. These branches, when they lie on the ground, have much the appearance of snakes, from the fissures in, and consequent varied color of, their bark; and they certainly have had the effect of scaring away the rats from my plantation. I need not say that each branch must lie singly on the ground.

W. H. SLEEMAN.

DISCOVERY OF COAL IN THE VALLEY OF THE NERBUDDAH.

We learn from the Agra Ukhbar that this mineral has been found by Captain Onseley, lying for 100 yards by 30 to 50 wide, and as far as excavated by the water, which Captain Onseley dug 3 to 4 yards thick. He is of opinion that very little expense would be incurred in working it. It is also situated in the plain about from $\frac{1}{4}$ to $\frac{1}{2}$ a mile from the hills to the south, the road from Hoshungabad to Nursingpoor and Jubbulpore being perfectly level.

2.—The expense of working it rests entirely on the scale directed, workmen are procurable in abundance for 2 annas, Nagpooree bullocks 3 to 4 annas, hackeries 6 annas per diem. Before a just estimate can be made, I should desire after the rains, to go to the place and sink a shaft or more to ascertain the real thickness and extent of the coal downwards, the correct dip of it and quality in the strata deeper.

That I sent for the Iron Steamers, to be tried, gave in

9 maund 3 maund of ashes.
9 maund Burdwan coal $3\frac{1}{2}$ maund of ashes.

Shewing this to be the better—although taken from the surface—which has been acted on by air and water for years; below, I doubt not the quality will prove as good as that of English coal.

The most important part of this discovery is, that it may tend towards making a rail road to Nursingpore, continued via Boorhanpore to Bombay, when locomotive engines would supersede the present slow dak establishment, the abolition of which would

Create a justifiable saving; transport of public stores, guns, and private property, such as grain, salt, and other weighty articles of commerce become easy; as also travelling; coals would of course be sent for the steam navigation on the Ganges from hence, for depôts in the Upper Provinces, and to Bombay for the Steamers to England.

The foregoing suggestion is, in our own opinion, perfectly practicable, and if the government were alive to its own interest, and that of the people, it would be instantly carried into execution. But another highly important communication is made on this subject, from the intelligent source to which we have alluded.

THE NAVIGATION OF THE NERBUDDAH.

It appears that the Government allowed Capt. Onseley to survey the Nerbuddah.

The survey of the Nerbuddah proved that for the whole length of its course it is now unfit for navigation of any kind; that means of transport is unavailable. The mines of iron ore are inexhaustible; adjacent to the coal, forests surround it to supply charcoal, and lime stone is abundant; it requires but the orders of Government to authorize adequate outlay to carry into effect that which would tend more to the improve-

ment of this country than any other means I am aware of. To superintend and conduct such a work, the Government do not want for scientific men, and ours is the only great power which has not hitherto resorted to such resources for the improvement of the country. The road from Mirzapoor to Jhansy Ghant, the border of the Nursingpoor district, is already complete, along which the rails might be laid; stone quarries are numerous along the whole line of road, from which sleepers for laying the rails in could be got; the rains would have no effect whatever in injuring the road, and wells already sunk or other supplies of water at convenient distances for the engines. To work the coal, without such means for the removal, would be of no advantage, even supposing that the expense of sending coal to the Upper Provinces from Calcutta be taken into consideration, land carriage so far (otherwise than by rail-road carriage) would be too expensive.

The following extract from a letter from Major General Sir I. Malcolm, G C B. will show his opinion as to the navigation of the Nerbuddah.

From a memorandum of Mr. Webbe, Revenue Surveyor, in the office of Major Williams, and a well informed man, it appears, that for seven or eight months in the year, large boats navigate the Nerbuddah, as high as Telekwarrah, without any inconvenience, and though they might go ten or twelve miles higher up the river, during a few months when it is at the highest, I see no advantage in fixing the depot of debarkation for stores above this town, which, from its size, healthiness, and the well cultivated country in its vicinity, is every way calculated for such a purpose.

I have quite established by the surveys of Lieutenants Hansard and Mathias, that the Nerbuddah from the Hurun Pahal or Deer's leap (as it is locally termed from the narrowness of the channel), where it enters the broken ridges of the Santpoorah range, to below the fall of Mukree, a short distance above Telekwarrah, is, from the rugged nature of its bed, its contracted streams, numerous rapids, and the formation of its banks, incapable of ever being rendered navigable throughout that space. This fact makes it indispensable to proceed from land by Telekwarrah to some point above the Hurun Pahal, and I should fix the place for receiving and protecting such stores and goods at or near Chiculdah, from whence they could be re-embarked and conveyed to Moheysir, or with a short passage of a few hundred yards at Sahasurdunah (or the thousand falls) to Mundleysir, from whence they can go with ease forty or fifty miles higher.

A memoradum from Lieutenant Mathias, shews, that even in April, when the river was at its lowest, he was able to go from Mundleysir to the Hurun Pahal in small craft, and that he went to Broach from Telekwarrah in a boat of tolerable size, as late as the month of May. The information received by this officer fully confirms that given by Mr. Webb, both as to the size of the boats (as large as 120 candies or 2,400 maunds burthen) employed in the trade between Broach and Telekwarrah.

Of the practicability of the navigation of the Nerbuddah between Chiculdah and Mundleysir (with the easy postage noticed), I could have no doubt from Lieutenant Mathias' observations, and I was also acquainted with the fact, that a trade between Chiculdah and Moheysir has always been carried on in small boats. But being anxious to establish this point, beyond the possibility of doubt, I requested Major Wilson accompanied by Captain Stewart of the 1st Cavalry to proceed to the Hurun Pahal, in the end of last month, when the small quantity of rain that had fallen rendered the river uncommonly low for the reason. The result of the examination of this part of the river was, that with the exception of the postages of Sahasurdunah near Moheysir, where the river from the falls or rather rapids is always very difficult and sometimes dangerous, the navigation between Mundleysir and Chiculdah was practicable for light craft nine or ten months in the year, and Major Wilson further informs me that from his inquiries, and from the meteorological observations he has made since he went to Mundleysir, the wind blows throughout this period almost always from the westward, increasing with the monsoon, and enabling boats, when the current is at its height of violence, to stem it and to come in two and three, and sometimes in one day from Chiculdah to Moheysir. The large and rather heavy passage boat in which he went down came up from Dherl (near the Hurun Pahal) passing the rapids at Sahasurdunah in four days. But the river between the Hurun Pahal and Mundleysir is almost in a straight line, which is a great advantage to the flat bottomed craft, as they have never to shift a sail in coming up, while in going down they are aided by the current, and where that is slow and the water shallow, they are punted.

These facts will satisfy Government, there are no charges of any consequence likely to arise out of the execution of this plan, and the following may be enumerated among the advantages with which it will be attended.

This Force now receives its arms, stores, and all European articles of public supply from Calcutta, by the way of Agra, which may be calculated as a water carriage of nearly four months, while the distance by land (which is 469 miles) may be computed as a march of two months.

By the line proposed, arms, stores, and supplies of all descriptions would come from Bombay to Broach, which is the Depot of that Presidency for the troops employed in its western territories, in four or five days. In an equal time, there would be landed at Telekwarrah, and the journey of one hundred miles over good roads to the entrepot at Chiculdah would easily be accomplished in eight or ten days and the remaining distance by water to Mundleysir would not occupy more than four or five days. At Mundleysir all that could be conveyed on elephants, camels and bullocks would be within one days, march of the Depot Jam, and two of Mhow, while what required wheel carriage being conveyed sixteen miles higher up the river (and the navigation is without obstruction), would go in three days, march to Mhow by the Sumtole Ghaut.

From the above statement it appears that arms, stores, and all articles of military supply might be brought from Bombay in a fortnight by water, and a fortnight by land carriage. The saving of money from this change of the channel of supply must be very great, and the difference of time between one and six months is also important. But this even is not so essential as the comparative strength of the two lines. From Broach to Mundleysir with the posts proposed at Telekwarrah and Chiculdah, I could protect the communication, under almost any circumstances, with a few companies of infantry, whereas that with Agra is exposed in a degree that would make it incapable of being kept open except by large bodies of men. This latter consideration may refer to an improbable state of affairs, but such calculations must be made in the establishment of all military lines, and particularly those by which troops receive their arms, ammunition, and stores.

My attention has been directed to the object of eventually opening the former direct intercourse between, Surat and Malwa, by Tikree and Sultanpoor, but this road has been abandoned for near a century and the greater part of it is completely overgrown. The country also is desolate, and the few scattered inhabitants are plunderers yet to be reclaimed. Some years, therefore, must elapse before this can be done. The late successful efforts of Captain Briggs in settling the districts of Sultanpoor, and the disposition which the Bheels have recently shewn to reform will no doubt accelerate its accomplishment, but that cannot affect the utility of the line now proposed, as the distance by land from Surat to Mundleysir by this direct route

is not less than two hundred and thirty miles, which is only about fifteen miles shorter than the road by Sindwa and Nunderbar, which has been the common line of communication between Surat and Malwa during the period the Mahratta Government has been established over the latter provinces.

Now it remains to be seen whether the Government will open its eyes to the immense advantages to be derived by these valuable discoveries, for which we are indebted to its talented and enterprizing public servants. We cannot conclude the subject without requesting particular attention to the sound logic and able opinion of the Editor of the Agra Ukbar on the foregoing subjects.

Our readers will recollect that we recently announced the discovery of a bed of coal near Gurrawara which we urged should be made available for the navigation of the Ganges by the construction of a rail-road under the Vindhaya Hills to Mirzapoor, a project which a citizen of New York or a member of the Stock Exchange would at a glance subscribe his money to, but which the Government of India regard as the suggestion of a heated imagination or the impracticable scheme of an ill-directed mind. The presence of the coal thus discovered, removes one great objection to the introduction of steam power on the Nerbudda, and thus the principal means of maintaining a constant communication open on two of the largest arteries of the country, if we may so use the word, the Ganges and Nerbudda, are placed in our hands, and we only require a little of that labour which nature wisely requires of man, to fashion them to our purposes. We need not dilate on the effect the full working out of this design would produce, or consider what a change had been brought about in the state of the country, had it and the other projects we have seen proposed of late years, been accomplished. The mere mention of them would indeed afford a melancholy contrast between the ardour and activity of individuals, and the apathy, not to say opposition, of Government. The most prominent of these plans had for their object the formation of an uninterrupted communication, which would have encircled the whole of Central India. From Calcutta to Agra the Ganges and Jumna offered an open and easy passage, the junction of the latter river with the Sutlege, by means of a canal, would have rendered the line of communication unbroken to the most northern part of our dominions; the opening of the Sutlege and the Indus would have brought us to Bombay, and the construction of a good road (and why not a rail-road), from the latter to Calcutta, would have completed a route, which would circumscribe the best portion of India, while the opening of the Nerbudda, and the formation of a road to Agra, would offer an opening through the centre of the circle we have described. All these projects have however been either tried and abandoned or totally neglected. The establishment of steam communication between Calcutta and Agra was tried, proved successful, and then given up—a canal to join the Jumna and Sutlege, furnished a few editorials to the useful papers and was then forgotten; the opening of the Sutlege and Indus was as every one knows a perfect farce, and might be likened to the opening of a trade under insupportable duties. Both of these rivers have been and will remain closed to us, until men of greater ability and capable of thinking more boldy and taking more extended views, than either Capt. Wade or Col. Pottinger, are employed as the agents of our Government in these quarters. The construction of roads from Bombay to Calcutta and Agra, and the navigation of the Nerbudda are measures which have scarcely yet had time to be forgotten, recently as they have been proposed, though we can scarcely hope a better fate for them than the others.

PROSPECTS OF STEAM NAVIGATION.

The following is a truly valuable communication, which we extract from the Bombay Courier.

The first point to be adverted to, and hitherto almost universally admitted in the discussion of this question, is the necessity of having large and expensive vessels with heavy powers, in order to ensure the certain completion of the passage; for it is believed to be only in such, that a sufficient supply of fuel can be carried to run long distances. The reason of this is, that as the size of a vessel is enlarged, the power may be made relatively less with the same degree of speed; and thus an increased number of days consumption of fuel can be carried without making the vessel draw too much water. For instance, taking Mr. Field's table, put in before the committee of the House of Commons, it requires a hundred horse power to propel a vessel of 250 tons, at the rate of 10 miles per hour; while a two hundred and forty horse power is sufficient to propel a vessel of 1000 tons at the same rate. The small vessel will only carry 5 days' coal, while the larger vessel will carry enough for 18 days' consumption.

So long as the correctness of this principle was admitted, and large expensive vessels were deemed necessary, it was clearly impossible that any return which steam communication could be expected to yield in this country could be at all proportionate to the outlay which it was necessary to make, in order to establish such communication, and its establishment thus seemed altogether a hopeless matter, unless government took the thing up as a public measure and defrayed the deficiency of return from the public treasury.

Fortunately, however, for the cause, circumstances have occurred of late years to show that if such proportions are necessary with paddle wheels of the common form, they are by no means so with paddle wheels on Mr. Morgan's principle, but that in vessels so fitted the proportion of power to tonnage may be made the same in both large and small vessels, and that the small vessel will make her voyage with quite as much certainty as the large one.—Vice Admiral Sir Pulteny Malcolm, in his evidence before the committee of the House of Commons, was the first who recommended moderate sized vessels with small powers and Morgan's wheels, as the best adapted for steam communication between Bombay and Suez.—He recommends vessels of 435 tons with engines of 100 horse power; and this recommendation was made after many years' experience of what could be effected by vessels of all sizes and power, from the Steam Frigate the *Medea*, with 220 horse power, down to the *Columbia* of 360 tons and 100 horse power, which latter vessel, by-the-bye, was first fitted with engines of 120 horse power; but these were taken out from having been found too heavy and replaced by the present engines, and the vessels' speed in every respect improved.

The following letters will, however, bear out this principle still farther, by fully showing that even the vessels of 435 tons proposed by Sir Pulteny Malcolm, may without disadvantage be still further reduced, with proportionate diminution of the cost of outlay, and with equal certainty of effecting the passage in the same time; for they show that the *Transit*, a vessel of 300 tons and 80 horse power with Morgan's paddle wheels, made the passage from Falmouth to Lisbon in April last, in four days, against strong contrary winds and a heavy head sea, beating the *Glasgow* steamer of 400 tons and 200 horse power by 40 *hours*, both having left Falmouth together.

Minerva Cottage, Tuesday, 3d May.

"Dear Sir,—I take the liberty of enclosing for your perusal, the copy of a letter my brother has this day received from Mr. Miller, of the firm of Miller, Ravenhill, and Co. conveying their engine-

worker's report of the *Transit's* voyage from Falmouth to Lisbon against heavy weather."

"The *Transit* and *Glasgow* left Falmouth together, and you will perceive the *Transit* beat the *Glasgow* by *forty hours*." "—The *Transit* is a vessel built on something of my brother's plan, about 300 tons, with a pair of 40 horse power and *our wheels*."

"The *Glasgow* may be 100 tons larger, *flat bottomed*, and a pair of 100 *horse power*, with the common wheels."

"In this instance the admirers of moderate sized vessels and large power will find they are beaten hollow by a moderate sized vessel with moderate power and our wheels."

Very respectfully, Sir, your's obliged,
RICHD MORGAN.

"The *Transit* was built for the Mediterranean and Levant Company, and was called the *Otho*."

Glass House Fields, May 2d, 1836.

"DEAR SIR,—I send you a foot, an extract of a letter just received from our Engine worker on board the *Transit*, which will inform you how very satisfactorily she is going on." Your's truly,
JOS. E. MILLER.

"GENTLEMEN,—I write to inform you that the *Transit* arrived at this port (Lisbon) on Friday evening, in four days from Falmouth, against strong contrary winds, with a heavy sea. The Engines perform very beautifully. I have not had any trouble with them at all The copper pipes answer the purpose very well, and we are now quite comfortable in the Engine department. We beat the *Glasgow* Steamer 40 hours from Falmouth; both vessels left Falmouth."

"The distance from Falmouth to Lisbon is 728 nautical miles, being 465 to Cape Finistre, 254 more to the mouth of the Tagus, and Lisbon is situated 9 miles inside the entrance of the river. The *Transit* therefore made good, under the circumstances detailed in the letters quoted above, 728 knots in 4 days, being 182 miles per diem, or $7\frac{7}{12}$ knots per hour for the whole distance. This would have been a very good average speed, even with fine weather and fair winds, but when it is stated to have been against a heavy sea and strong contrary wind, it is indeed excellent.

With this example before us, I think no reasonable man, can doubt the perfect fitness of vessels of the same description as the *Transit* for keeping up a steam communication between Bombay and Suez; for it is certain that a vessel sufficiently powerful to cross the Bay of Biscay against a contrary wind and heavy sea, at the rate of $7\frac{7}{12}$ knots per hour, could always average at least the same speed with any weather she is likely to encounter in the Indian seas for 9 months in the year.

It having been thus ascertained that a vessel of such moderate size and power is fully sufficient for keeping up steam communication, it now only remains to estimate the cost and circumstances under which three vessels of this description could be placed in Bombay harbour, ready for use, and what would be their expences in running monthly trips for 9 months in the year.

The first point is to ascertain what would be the prime cost of three such vessels, and to do this Sir Pulteny Malcolm's and Mr. Morgan's evidence before the committee of the House of Commons afford the necessary data upon which the following estimate has been framed, and to which, in order to ensure its being fully sufficient to cover every possible outlay, I have added 10 per cent. for contingencies, after every item, including one spare set of copper boilers, has been provided for.

Outline Estimate of expence of procuring from England three Steam Vessels, each 300 tons burden and fitted with a pair of 40 horse power engines, copper boilers, and Morgan's Patent Paddles.

	L. s. d.
A vessel of 300 tons river-built in the best manner, at £20 per ton......	6,000 0 00
A pair 40 horse marine engines, without boilers, at £45 per horse power	3,600 0 00
Copper Boilers at £43 per horse power	3,440 0 00
Duplicate parts..	1,200 0 00
	14,240 0 00
Two more vessels at the same rate....	28,480 0 00
One set duplicate boilers............	3 440 0 00
Lathes, tools and forges..............	1,500 0 00
	47,660 0 00
Expence of sailing out..............	2,500 0 00
	50,160 0 00
10 per cent. contingencies............	5,016 0 00
	£ 55,176 0 00

N. B.—Sir Pulteny Malcolm estimates the total cost of 3 vessels of 435 tons each, and 100 horse power with duplicate parts &c. built in England and sailed out to Bombay only at £61,800, so that the above estimate must be amply sufficient to cover every item of prime cost.

The next point for consideration is the expence of running such vessel; and on this point also there is much valuable information in the evidence of Sir Pulteny Malcolm and Mr. Morgan; and in other respects where their estimates are too low, I have fortunately by me the monthly expence of the Hon'ble Company's Steamer *Irrawady*, a vessel of the same size and power as those now proposed; and this I have assumed as a scale for measuring the expence of wages to the establishment.

The next item is the quantity of coal which would be consumed and its cost.—In order to ascertain this it is necessary to estimate the number of hours during which each vessel must be under steam in each passage.—It would in every respect be most desirable, in order to economise in this respect, to divide the distance more equally than is effected by the present arrangement of depôts, and this from information which I have lately received seems exceedingly feasible. Hulanea—the largest of the Curia-Muria islands—has safe anchorage during both monsoons, and is only about 950 miles from Bombay.—Camaran, an island a short distance within the straits of Babelmandel, has an exceedingly good harbour and plenty of water. It is about 970 miles from Hulanea.—From Camaran island to Suez is about 1000 miles, and might form the third stage, coal being deposited at Suez from Alexandria for the return trip.—Reckoning an average of only 7 knots per hour, each of these stages would be completed in 6 days at the very utmost, or each vessel would make the trip to Suez in 18 days under steam; and reckoning by the passage of the *Transit*, would no doubt, under favorable circumstances, complete the trip within 16 days steaming.—Two days stoppage at each depot would complete the passage in 22 and 20 days from Bombay.—Reckoning 18 days under steam, each vessel with an 80 horse power would consume $8\frac{1}{2}$ tons of coal per diem, or about 150 tons for a single passage, being for 18 passages 2,700 tons, and allowing 10 per cent for waste it would require about 3000 tons coal per annum, to make 9 monthly double trips with vessels uch as those in question.—Supposing coal to cost in Bombay 15 Rupees per ton, and I have reason to believe that it could be had, under proper arrangements, at 12 Rupees, and supposing the cost in the Red Sea to be 25 per ton, it give an average throughout, of Rupees 20 per ton as the price of coal, at which cost I have reckoned in the annexed estimate.

The items, charge of engine room, repairs of machinery and boilers, and maintenance of vessel, are extracted from Mr. Morgan's estimate for a vessel

of 400 tons and 100 horse power. With these remarks premised, I may annex the following estimate of the probable annual cost of maintaining three vessels ?—

Estimate of the annual expence of three vessels-

Wages of one vessel, as per appendix No. 1. at 2,300 per month......	27,600
Two more at the same rate..................	55,200
3,000 tons of coal, at Rs. 20 per ton........	60,000
Annual charge for engine room supplies for one vessel.............	2,500
Repairs of machinery, ditto..........	2,000
Repairs and replacing boilers, ditto ...	3,800
Maintenance of vessel, ditto,..........	2,800
	11,100
Three vessels................................	33,300
	176 100
Interest on outlay at 5 per cent,............	27,588
	203,683

As it may be doubtful whether coal cannot be deposited at a more moderate rate via the Red Sea at Cossier, than via Alexandria at Suez, it is suggested that in this case the whole of the supply required for the return trip might in the first instance be deposited by ships from England at Camaran island, from whence it might be conveyed to Cosseir in country craft. The steamer might halt six hours at Cosseir on her way both up and down, drop passengers wishing to land there, and in her way down picking up those waiting for a passage. She could at the same time fill in sufficient coal in going up to take her to Suez and back, and in going down to take her to Camaran, which would thus become the principal depot in the Red Sea.

If my rate for coal be reckoned too low at 20 Rupees per ton, the knowledge of mercantile men in Bombay can easily correct this item.

The last point for consideration, and the one of most importance is, what return could be expected to meet the expenses of all this outlay, and the subjoined estimate is hazarded as a rough approximation, on a scale by no means extravagant :—500 Rs. is assumed as the value of a passage to the ship, leaving passengers to make their own arrangements with the Captain for their living ; or the various steamers might have a steward or purveyor who might furnish any thing called for, as well as breakfast and dinner, at fixed rates ticketed on a board. Sailing vessels to the Red Sea charge from 3 to 600 Rupees for a passage, and 500 cannot therefore be reckoned an extravagant charge for the expedition and comfort of a steam vessel. With regard to the number of passengers assumed, and the return of 6000 Rupees for each single trip for letters and parcels, I can merely say, that if such a number did not take advantage of the establishment of steam communication, and if the number of letters, &c. is to fall short of the sum above stated, then it is idle to talk of steam communication to India, for the country, that cannot or will not furnish so moderate a return, is not worthy of the boon. I fancy, however, the general opinion will be, that the returns will rather exceed than fall short of the annexed —

Estimate of returns from three vessels performing 9 trips per annum.

12 homeward and six outward passengers, per month, or 162 per annum, at per each, Rupees 500..............................	81,000
Letters, parcels, treasure, deck passengers, &c. say per trip Rupees, 12,000 – 6,000 towards England and the same towards India	1,08,000
Returns..	1,89,000
Expences	2,03,688
Deduct,..............Apparent deficiency	14,638
Interest on the steam funds of the three presidencies, £25,000 sterling, which is to be given as a bonus at 5 per cent..............	12,500
Apparent net deficiency of returns to meet expences........................ ......Rupees.	2,188

N. B. If Government (as it is not improbable they might,) would come forward with a bonus of another lakh, or lakh and a half of Rupees, to assist the steam funds in the first outlay in purchasing vessels and machinery, there is little doubt that the returns would fully cover the current expenses, and even leave a profit : but whether this is done or not, it is understood that government would pay for the transmission of their dispatches at the same rate as individuals, and that the British consul should see to the transport of the mails through Egypt.
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APPENDIX.

Statement of the establishment of the Hon'ble Company's steam vessel Irrawaddy, 300 *tons burthen, and* 80 *horse power.*

Crew.	Old scale.	New scale from 1st Nov. 1830
1 Commander........	400 0 0	500 0 0
Table allowance for himself and 2 officers............	300 0 0	
1 Chief officer..............	260 0 0	250 0 0
1 Second officer............	150 0 0	200 0 0
1 Engineer at 250 per month. 41. 10 8 payable in England	208 5 4	
Table allowance to ditto, at 2 rupees per diem........	60 0 0	
1 Assistant Engineer......	200 0 0	
1 Carpenter................	35 0 0	
1 Butler	20 0 0	
1 Cook....................	12 0 0	
1 Servant.................	8 0 0	
4 Sea cunnies, at 16 each per month..	64 0 0	
1 Syrang.... ...—........	20 0 0	
2 Tindals at 15 each per month	30 0 0	
24 Lascars, at 9 "......do..	216 0 0	
2 Topasses, at 7 ".....do..	14 0 0	
10 Stokers, at 16 ".... .do..	160 0 0	
Victualling 47 men, at 4 per month each	188 0 0	
Sicca Rs	2,285 5 4	

STEAM COMMUNICATION WITH INDIA VIA SWAN RIVER.

A correspondent of the Bengal Hurkaru, mentions, a Western Australian Company, or Association, being about to be formed, what say nautical men to the practicability of Steam Navigation between England and Bengal, via Swan River Colony ? Coals can be sent to the depots from England and New South Wales.

England, Azores, or Western Isles, Madeira, Santa Cruz in Teneriffe, St. Vincents, Cape de, Verd, or Salt, Islands. Fernando Po, Cape of Good Hope, Isles of S. Paul and Amsterdam.

Days 105 Swan River, Western Australia. 15 Keeling, or Coco, Isles, 5 Ceylon, 2 Madras, 7 Calcutta, (Bengal) 32 Days. Total 137 by a sailing vessel, or by Steam 68 or 76 days.

TO CORRESPONDENTS.

The works by Col. Sykes, and Proceedings of the Statistical Society and other works for Review will be noticed next month. The extent of important foreign Scientific intelligence in our present number has limited the number of articles under Review.

No. 10, June 1837

THE INDIA REVIEW

OF WORKS ON SCIENCE,

AND

JOURNAL OF FOREIGN SCIENCE AND THE ARTS,

EMBRACING

MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS, &c.

REVIEW.

Sugar, as to the probability of an improvement in the cultivation and quality of, either through Europeans or Natives, in case of an increased demand: From the report of the select commitees of the Houses of Lords and Commmons, appointed to enquire into the present state of the affairs of the East India Company, 1830-31.

Bell's Comparative View of the External Commerce of Bengal, during the years 1834-35 *and* 1835-36, *pp.* 106.

A Treatise on the Cultivation of Sugar canes, and the manufacture of Sugar, comprehending instructions for planting, and saving the cane, expressing the juice, &c. &c. By W. Fitzmaurice, *many years a planter in the island of Jamaica, pp.* 69, 1830.

The nature and properties of the Sugar-cane, with practical directions for the improvement of its culture and the manufacture of its products. By George Richardson Porter, *Philadelphia, pp.* 354, 1831.

A Dictionary, Practical, Theoretical, and Historical, of Commerce and Commercial Navigation: illustrated with Maps and Plans. By J. R. McCulloch, Esq. *Second Edition, Corrected throughout, and greatly enlarged: with a Supplement, supplying the deficiencies and bringing down the information contained in the work to October,* 1835. 8*vo. pp.* 1327. Longman, Rees, Orme, Brown, Greene, and Longman, London, 1835.

(Continued from page 371.*)*

In our last we alluded to the views of Mr. Fitzmaurice on the cultivation of sugar in India. Before we revert to the evidence given before the Committee appointed by Parliament to enquire into the subject, by way of relief to ploughing, digging, and planting, we turn to the history of the sugar cane, in order to prefer the claims of this country to its discovery. Such information is at this moment of vital importance to the commercial community of British India; for, considered with reference to the vast amount of capital the sugar trade is likely to employ, and the extent of public revenue it will as a consequence yield, the trade will open an ample employment for our shipping, by commencing a steady and extensive market with all parts of the world, and such will be its increase that, by giving occupation to British sojourners in this country, distress, nay indigence, now too common among them, will disappear. Respectability and intelligence will result from the industry thus effected, and the mercantile interest of this country will pro-

bably be raised ere long above that of any other country in the world. In tracing the history of sugar, we naturally refer to the most ancient writings in Sacred Writ. The first passage in which it is mentioned, is Exodus,xxx. 23,wherein Moses is commanded to make an ointment with myrrh, cinnamon, kené,and cassia. Comparing this passage with that in Jeremiah, vi. 20, we find kené mentioned as coming from a distant country. "To what purpose cometh there to me incense from Sheba, and the sweet cane from a far country." If any credit be due to etymology, the word kené denotes the sugar cane, from the Latin word *cana* and the English word *cane.* This sugar cane must have come therefore from the East Indies. Strabo relates that Nearchus found it in the East Indies in the year before Christ 325. Dioscorides says that there is a kind of honey called saccharine which is found in India. Pliny alludes to its being produced in India. Arrian, in his Periplus of the Red Sea, mentions *sacchar* as an article of commerce from India to the Red Sea. Thunberg found it in Japan; Marco Polo found it in abundance in Bengal. Porter, the author of one of the works under review, says that the Persians, Egyptians, Phœnicians, and Grecians, who went through the greater part of Asia, make no mention of the sugar cane before the period when merchants first began to trade to India. The merchants among the Jews, Christians, Romans,and Mahomedans, learnt from the Indians, who carried sugar to Mustino Ormus, that it was obtained from a reed: upon this tradition it is stated that the inhabitants of Asia sought among their reeds for that one which yielded so precious a product, and found it in a kind of bamboo called *mambu,* the young suckers of which are filled with an agreeable juice alluded to by Lucian, "*quique bibunt tenerâ dulces ab arundine succos.*" It is described to be a kind of honey which formed itself without the assistance of bees, (Strabo.) That it was a shower from heaven which fell upon the leaves of the reed (Seneca), and that it was a concretion of the reed in the manner of gum, (commentators on Pliny.) The first correct account of traffic in sugar is given by Marco Polo: the merchants, who had before his time gone to Ormus for the purpose of traffic, with the Indians, brought away the sugar cane and silk worm from thence; thus the sugar cane was introduced into Egypt and Arabia. Our authority for this fact is the works of Barthema, Giovanni, Lioni, &c. It is stated that, at the end of the fourteenth century, the cultivation of the sugar cane and the manufacture of its juice were known generally throughout Arabia, Egypt, and several other parts of Africa. According to Giovanni, in the sixteenth century an extensive trade in sugar was carried on in Arabia Felix, Nubia, Egypt, Morocco,and Ethiopia. We are ignorant as to the date of its importation into Europe. We find William the Second, king of Sicily, giving to the monks of St. Bennett a mill for grinding sugar canes. In 1420, Don Henry introduced the sugar cane in the island of Madeira from Sicily, where it was successfully cultivated, as well as in the Canaries. The Portuguese began the cultivation of the cane in the island of St. Thomas in 1820: this colony had more than 60 sugar manufactories (Racueil des Voyages). It was attempted to plant it in Provence, but the cold of winter destroyed it; it was, however, introduced in Spain, where sugar manufactories are at the present period. It was after Columbus discovered the new world, that Pierre d'Etienne took the sugar cane to Hispaniola, since called St. Domingo, and now Hayti. A Catalonian, named Michel Ballestro, was the first who expressed juice from it; and Gonzalves de Velosa was the first who concentrated this into sugar. At St. Domingo it grew to the size of a man's waist, where in 1518 there were 28 manufactories. On the authority of MacLeod it is stated that its cultivation extended with such prodigious rapidity,and its produce was so considerable, that the cost of the magnificent palaces of Madrid and Toledo, which were erected in the reign of Charles the Fifth, was entirely defrayed by the proceeds of the port duties on

the sugar imported from Hispaniola. The establishment of sugar plantations in America took place at the end of 1580. Sugar was made by the English in the island of St. Christopher, in 1643; by the French at Guadaloupe, in 1657. In 1466, however, the use of sugar was confined to medicine and feasts. What is very remarkable on looking back into the history of the sugar cane, we find that perfection had been attained by the Indians in crystallizing sugar, according to the soundest principles of chemistry. The Venetians introduced sugar refining into Europe at the end of the fifteenth century. At first they imitated the Indians, and sold the sugar which they purified in the shape of candy, clearing and refining the coarse sugar of Egypt three or four times over. They afterwards adopted the use of cones, and sold refined sugar in loaf. Sugar refineries were soon established in all the commercial cities in Europe, and were multiplied in the same ratio with the trade of America in sugar.

With the foregoing outline we arrive to the sugar trade, and we are able, by the latest addition of McCulloch's work now before us, to put our readers in possession of the most correct intelligence on this subject.

SOURCE WHENCE THE SUPPLY OF SUGAR IS DERIVED.—The West Indies, Brazil, Surinam, Java, Mauritius, Bengal, Siam, the Isle de Bourbon, and the Philippines, are the principal sources whence the supplies required for the European and American markets are derived. The average quantities exported from these countries during each of the 3 years ending with 1833 were nearly as follows:—

British West Indies, including Demerara and
  Berbice.......... .. 190,000 tons.
  Mauritius 30,000
Bengal, Isle de Bourbon
  Java, Siam, Philippines,
  &c.................. 60,000
Cuba and Porto Rico.. 110,000
  French, Dutch, and
  Danish West Indies 95,000
  Brazil 75,000
  ———560,000 tons.

Loaf or lump sugar is unknown in the East,* sugar candy being the only species of refined sugar that is made use of in India, China, &c. The manufacture of sugar candy is carried on in Hindostan, but the process is extremely rude and imperfect. In China, however, it is manufactured in a very superior manner and large quantities are exported. When of the best description, it is in large white crystals, and is a very beautiful article. Two sorts of sugar candy are met with at Canton, viz. Chinchew and Canton; the former being the produce of the province of Fokien, and the latter, as its name implies, of that of Canton. The chinchew is by far the best, and is about 50 per cent. dearer than the other. Chinese sugar candy is consumed, to the almost total exclusion of any other species of sugar, by the Europeans at the different settlements throughout the East. There were exported from Canton, in 1831-32, by British ships, 32,279 piculs (38,427 cwt.) of sugar candy, valued at 242,000 dollars; and 60,627 piculs (72,175 cwt.) of clayed sugar, valued at 318,256 dollars; and during the previous year the exports were about 50 per cent. greater. The exports by the Americans are also considerable. At an average, the exports of sugar from Canton may be taken at from 6,000 to 10,000 tons; but of this only a small quantity finds its way to Europe. The exports from Siam and Cochin-China are estimated at about 12,500 tons.

CONSUMPTION OF SUGAR IN EUROPE, &c.—Mr. Cook gives the following Table of the imports of sugar into France and the principal Continental ports in 1831, 1882, and 1833, and of the stocks on hand on the 31st of December of each of these years:—

	Imports.			Stocks, 31st of December.		
	1831.	1832.	1833.	1831.	1832.	1833.
	Tons.	*Tons.*	*Tons.*	*Tons*	*Tons*	*Tons*
France..	97,450	82,000	79.500	25,870	9,350	10,450
Trieste..	17,950	22,400	13,800	6,900	11,900	6,840
Genoa..	9,500	10,500	6,800	1 560	2,200	2,180
Antwerp..	5,240	8,780	12,800	2,000	2 000	5,100
Rotterdam..	10,700	11,600	8,650	1,800	3,900	3,350
Amsterdam..	18,370	22,380	20,100	2,200	3,400	5,300
Hamburgh..	38,800	37,930	30,000	9,000	13,400	9,820
Bremen..	12,380	12 500	7,350	3,230	5,800	3,550
Copenhagen	5,350	5.850	5,560	800	2,370	1,830
Petersburgh	11,170	23,100	18,500	8,440	11,660	15.600
	226,910	237,040	203 060	61.740	65,980	64,020

This Table does not, however, give the imports into any of the ports of the Peninsula. But the consumption of Spain, only, has been estimated, apparently on good grounds, by

* Loaf sugar is manufactured in great perfection in Bengal. *Edit. India Review.*

M. Montveran (*Essai de Statistique sur les Colonies*, p. 92.), at 45,000,000 kilog. (41,050, tons). This may appear large for a country in the situation of Spain; but the quantity is deduced from comparing the imports with the exports; and it is explained partly by the moderation of the duties, and partly by the large consumption of cocoa, and other articles that require a corresponding consumption of sugar. Mr. Cook's Table also omits the imports into Leghorn, Naples, Palermo, and other Italian ports. Neither does it give those into Stettin, Königsberg, Riga, Stockholm, Gottenburgh, &c. It is, besides, very difficult, owing to transhipments from one place to another, accurately to estimate the real amount of the imports. On the whole, however, we believe that we shall be within the mark, if we estimate those for the whole Continent at from 285,000 to 310,000 tons, including what is sent from England.

The following Table, compiled from the best authorities, exhibits the total consumption of colonial and foreign sugars in France at different periods since 1788, with the population, and the average consumption of each individual.—(See *Montveran, Essai de Statistisque*, p. 96., and the authorities there referred to.)

Years.	Consumption.	Population.	Individual Consumption.
	Kilog.		*Kilog.*
1788	21,300,000	23,600,000	·906
1801	25,200,000	31,000,000	·813
1812	16,000 000	43.000 000	·372*
1816 to 1819 average	36,000,000	30,000,000	1·200
1819 — 1822 — .	47,000,000	30,833,000	1·566
1822 — 1824 — ..	47,250,000	31,103,000	1 518
1824 — 1825 — ..	55,750,000	31,280,000	1·782
1826 — 1827 — ..	62,500,000	31,625,000	1·976
1830 — ..	67 250.000	31,845,000	2·126

This, however, is independent of the consumption of indigenous sugar—(see *post*), and of the sugar introduced by the contraband trade,—both of which are very considerable. The entire consumption of all sorts of sugar in France in 1832, including from 8,000,000 to 9,000,000 kilog. of beet-root sugar, and allowing for the quantity fraudulently introduced, may be estimated at about 88,000,000 kilog, or 193,000,000 lbs., which, taking the population at 32,000,000, gives an average consumption of 6 lbs. to each individual, being about ⅓th part of the consumption of each individual in Great Britain! This extraordinary discrepancy is no doubt ascribable to various causes;—partly to the greater poverty of the mass of the French people; partly to their smaller consumption of tea, coffee, punch, and other articles that occasion a large consumption of sugar; and partly and principally, perhaps, to the oppressive duties with which foreign sugars are loaded on their being taken into France for home consumption.

The United States consume from 70,000 to 80,000 tons; but of these, from 30,000 to 40,000 tons are produced in Louisiana.

About 170,000 tons of sugar are retained for home consumption in Great Britain, and 17,000 tons in Ireland; exclusive of about 12,000 tons of bastards, or inferior sugar, obtained by the boiling of molasses, and exclusive also of the refuse sugar and treacle remaining after the process of refining.

On the whole, therefore, we believe we may estimate the aggregate consumption of the Continent and of the British islands at about 500,000 tons a year; to which if we add the consumption of the United States, Turkey, &c., the aggregate will be nearly equivalent to the supply. The demand is rapidly increasing in most countries; but as the power to produce sugar is almost illimitable, no permanent rise of prices need be looked for.

Taking the price of sugar at the low rate of 1*l*. 4*s*. a cwt., or 24*l*. a ton, the prime cost of the article to the people of Europe will be 12,000,000*l*. sterling; to which adding 75 per cent. for duty, its total cost will be 21,000,000*l*.! This is sufficient to prove the paramount importance of the trade in this article. Exclusive, however, of sugar, the other products of the cane, as rum, molasses, treacle, &c., are of very great value. The revenue derived by the British treasury from rum, only, amounts to nearly 1,600,000*l*. a year.

PROGRESSIVE CONSUMPTION OF SUGAR IN GREAT BRITAIN.—We are not aware that there are any authentic accounts with respect to the precise period when sugar first began to be used in England. It was, however, imported in small quantities by the Venetians and Genoese in the 14th and 15th centuries†; but honey was then, and long after, the principal ingredient employed in sweetening liquors and dishes. Even in the early part of the 17th century, the quantity of sugar imported was very inconsiderable; and it was made use of only in the houses of the rich and great. It was not till the latter part of the century, when coffee and tea began to be introduced, that sugar came into general demand. In 1700, the quantity consumed was about 10,000 tons, or 22,000,000 lbs.; at this moment, the consumption has increased (bastards included) to above 180,000 tons, or more than

* Continental system and empire.

† In Marin's *Storia del Commercio de' Veneziani* (vol v. p. 306), there is an account of a shipment made at Venice for England in 1319, of 100,000 l s. of sugar, and 10,000 lbs. of sugar candy. The sugar is said to have been brought from the Levant.

400,000,000 lbs.; so that sugar forms not only one of the principal articles of importation and sources of revenue, but an important necessary of life.

Great, however, as the increase in the use of sugar has certainly been, it may, we think, be easily shown that the demand for it is still very far below its natural limit; and that were the existing duties on this article reduced, and the trade placed on a proper footing, its consumption, and the revenue derived from it, would be greatly increased.

During the first half of last century, the consumption of sugar increased five-fold. It amounted, as already stated—

In 1700,	to 10,000 tons	or	22,000,000 lbs.
1710,	14,000 —		31,360,000 —
1734,	42,000 —		94,080,000 —
1754,	53,270 —		119,320,000 —
1770--1775	72,500 (average)		162,500,000 —
1786--1790	81,000 —		181,500,000 —

In the reign of Queen Anne, the duty on sugar amounted to 3*s*. 5*d*. per cwt. Small additions were made to it in the reign of George II.; but in 1780 it was only 6*s* 8*d*. In 1781, a considerable addition was made to the previous duty; and in 1787 it was as high as 12*s*. 4*d*. In 1791 it was raised to 15*s*.; and while its extensive and increasing consumption pointed it out as an article well fitted to augment the public revenue, the pressure on the public finances, caused by the French war, occasioned its being loaded with duties, which, though they yielded a large return, would, there is good reason to think, have been more productive had they been lower. In 1797, the duty was raised to 17*s*. 6*d*.; 2 years after, it was raised to 20*s*.; and, by successive augmentations in 1803, 1804, and 1806, it was raised to 30*s*.; but in the last-mentioned year it was enacted, that, in the event of the market price of sugar in bond, or exclusive of the duty, being, for the 4 months previous to the 5th of January, the 5th of May, or the 5th of September, below 49*s*. a cwt., the Lords of the Treasury might remit 1*s*. a cwt. of the duty; that if the prices were below 48*s*., they might remit 2*s*.; and if below 47*s*., they might remit 3*s*., which was the greatest reduction that could be made. In 1826, the duty was declared to be constant at 27*s*., without regard to price; but it was reduced, in 1830, to 24*s*. on West India sugar, and to 32*s*. on East India sugar.

The duty on foreign sugars is a prohibitory one of 63*s*. a cwt. Sugar from the Mauritius is however, by a special provision, allowed to be imported at the same duty as West India sugar.

Art. II.—Notes on Persia, Tartary, and Afghanistan. By Lieut. Col. Monteith, K. L. S. *of the Madras Engineers.—Madras Journal of Literature and Science.*

Defence of British India from Russian Invasion. By Captain C. F. Head, *Queen's Royal Regiment.*

(Continued from page 374.)

The author of this paper is well known for having drawn attention to steam navigation as being of public advantage and private accommodation in facilitating communication between India and Europe; but, above all, as an auxiliary either in maritime or territorial defence, should any European enemy attempt to approach the borders of Hindustan. Capt. Head thought, with many others who were capable of judging, that a political crisis may arise sooner than is expected, when the strength of western nations will be put forth, and a struggle take place, in which each vulnerable portion of the British empire will become a point of assault. Our author does not hesitate to avow that Russia will endeavour to close with England in this country, and that success will depend on the development of her great military prowess, and where the co-operation of a maritime force is least required. The war between Russia and Persia demonstrated the strength and resources of the northern autocrat, but its result exposed the weak and compromising character of Asiatics; while it proved the alacrity with which the inhabitants of provinces contiguous to Russia will join in any expedition that promises a fair reward. In considering the question, says Capt. Head,

"It will be necessary to bear in mind, throughout the enquiry, that an invading army, of however crude and opposite materials it may be composed, will take the field with great odds in its favour, from the circumstance of its object being defined, and the duty of every man being made apparent. Whereas, an army acting on the defensive can hope for no reward even after a hard-earned victory; at the same time that they are liable to the harassing duty of continually watching the movements of their enemy. If the patriotic feeling which causes men to defend their soil, and feel a hatred towards the invaders, could be imparted to the natives of India, then would the territory of Hindoostan be comparatively safe. But how little is this to be expected in the case we are contemplating, where the people of the country have at the best of times so little perseverance and energy, and where an army that

would be collected to defend any frontier must be composed of a variety of nations, differing in language and religion, strangers to the region they are fighting in, and assembled from provinces as little known to each other as are the various states of Europe. We must also consider the inherent desire in kings and in subjects for aggrandisement. Russia, which is now in direct collision with nations that are to be as easily overcome as were those of British India, will, no doubt, pursue her advantage and extend her boundary towards the East, and Great Britain will, in all probability, ere long, have to contest her right of sovereignty over three-fourths of her subjects, included in the population of Hindoostan.

When it is remembered that the colossal power of Russia has attained its present eminence in three half centuries, or since the master-spirit of Peter the Great brought his people to rank with civilized nations, and caused the empire, of which he laid the foundation, to increase in population from sixteen to sixty millions, a moment's reflection will suggest the prudence of speculating with regard to its future progress. At present the disciplined legions of Russia are rated at 900,000, and they have tried their strength with success against most of their neighbours. The nations towards the east and south have felt and admitted the superiority of their discipline, and will hereafter prefer an amicable alliance to another useless struggle. The territory of Russia has had a proportionable increase with her subjects, and has extended so much in Asia as to leave but a frail barrier between the armed giant of the north, and the commercial Colossus of Hindoostan."

We do not consider the foregoing picture in the least over drawn. The opinion entertained by our author is that, of all men thoroughly acquainted with the subject, the Indian Government alone seem to regard it least. Our author proceeds to take a general view of the different routes by which a Russian force may invade India. The widely extended southern frontier of the Russian empire, which in longitude sweeps over nearly one half of the whole globe, admits of a military force advancing from that territory towards India from four distinct points. By the most westerly route the line of operations is the longest, and the subjugation of Persia would become necessary. These would require a second campaign before Russia could reach India. The south shores of the Black Sea would be the basis for a first series of movements, and Herat, a city on the eastern boundary of the Persian empire, would be the station whence arrangements for a second campaign would emanate, and from which the invaders would advance towards our possessions. Another plan the enemy would adopt is, to pass from Russia to the Indus, by establishing a depot, by means of the Volga river at a station on the shore of the Caspian Sea. Our author is of opinion that by this route, the line of march would be considerably reduced, and a demonstration only towards Persia would be made on the south of the Black Sea. In effecting an invasion by this route, the co-operation of Persia, and not its subjugation, would be necessary—an auxiliary the most feasible and likely to be attempted. The third line of advance is from the east shore of the Caspian Sea across a desert to Khiva, on the Oxus or Amu river, thence to Balkh, and by a caravan route to the Indus. These routes being more to the eastward are shorter, and an advance by them could be executed with rapidity. Captain Head is of opinion that the success of the enterprize would be more precarious than by the western routes, and might be looked upon in the light of a *coup-de-main*. All these routes have engaged the attention of the Government of St. Petersburgh. We have ample information regarding these routes, furnished from statistical details collected by embassies which have proceeded from Russia to the cities of Kokhhand, Bokhara, and Khiva, with a view of opening a communication with these places; and opinions on the subject are freely circulated in the Russian capital. Captain Head is of opinion that, for a European power to undertake the invasion of Persia or India, there is no spot east of Constantinople better calculated for assembling a large force than the plains of Erzeroom: horses and cattle are cheap, and abundant forage is every where to be procured in the spring and summer, and a considerable stock of corn may be collected from the neighbouring provinces. Erzeroom is but a short distance from the port of Trebizond on the Black Sea, through which all requisite stores could be readily supplied. Erzeroom is, in like manner, an advantageous position for an advance into Persia. As at the present moment the public mind is directed towards

Herat, and the apprehension being that it is the policy of Russia to occupy Persia before a force is pushed forward to invade India, the campaign will be opened by having the eastern frontier of Persia or the city of Herat as the basis of operations. Those of our readers, who belong to the profession of arms,will be glad to have a description of the place. Herat is described as standing in a fertile plain, watered by a river, crowded with villages,and covered with fields of corn. The town contains 100,000 inhabitants.

"It holds a central position, at almost an equal distance from the cities of Kerman, Yezd, Tubbus, Toorsheez, Mushed, Bokhara, Balkh, and Candahar. It is one of the greatest emporiums of the commerce of Asia, and could draw supplies from all the places we have enumerated, and from many more of minor importance. The city itself is placed in a fertile and well watered valley, and is surrounded by extensive gardens and pastures. It enjoys a fine climate, it is amply stored with provisions at all times; it could, as we have stated, draw supplies from all the countries around it, and it is capable of furnishing every article which these countries afford. If any place is worthy to be designated, 'the key to India,' it certainly is Herat." We are also told that a considerable number of horses are bred in the Cabul dominions, and those of Herat are very fine. Camels are, however, on the whole, the animals most employed for carriage. The ox is used to plough, except perhaps in Balkh, where horses are so common.*

Having arrived at this favourable position, distant from the Indus between 700 and 800 miles, over roads that are in constant use for caravans, it is necessary to remark that Herat is accessible from Russia by another route, the greater part of which passes through a fertile country, that lies between this city and the south of the Caspian Sea. It will be examined, before we proceed to enquire into the nature of the intervening country between Herat and the Indus. The line of advance from the Caspian to Herat, is the second alluded to in the beginning of this enquiry. There can be little doubt but it would be the one adopted by a Russian army, and it will be found about 600 miles in length. The distance will therefore be no more than between 1300 and 1400 miles from the Caspian Sea to the Indus; the bare possibility of its practicability ought to be considered with attention.

Whether Persia is or is not occupied, there would be a body of irregular horse of that country, at the command of Russia, to keep open the communication between the Caspian and Herat, in case any disposition to interfere should be shewn by the Tartar tribes on the banks of the Oxus. The Persians have an hereditary and inveterate hatred towards the people of that country, and would readily accept the assistance of Russia, to be enabled to revenge themselves for former insult. Supposing, then, it became the policy of Russia to forego the conquest of Persia, and to purchase her co-operation by promises of future rewards, an army destined to invade India would proceed to the occupation of Herat by this last named route passing through the province of Khorassan.

By means of the Volga, the Caspian Sea communicates with the heart of Russia, the inland navigation from Astracan, which lies at the mouth of that river, goes over a tract of 1434 miles, and passes through the most fertile regions of the empire. There is also a water communication between Astracan and St. Petersburgh, by means of the celebrated canal of Vishnei Voloshok.* Astracan is the great staple of the Caspian commerce, and is readily supplied with European merchandise from the ports of the Baltic. In the fourteenth century Europe was supplied with the produce of India, through the Caspian Sea and Astracan, and a direct communication with India has continued by the same route, which is that we are about to inquire into. The Caspian Sea, which has a length of 640 miles, and a breadth of 200,is navigated by vessels drawing from 9 to 10 feet water. There are extensive fisheries on it, which cause numerous vessels to be employed. Such facilities of conveyance formed to communicate with St. Petersburgh, and other cities of the empire, would render the transportation of an army to the opposite shore of easy accomplishment, whilst the uninterrupted navigation of the sea by Russia would also ensure a regularity of supplies. At Astracan there is a large and commodious harbour, with a dock yard and spacious quays. In July 1723, Peter the Great assembled an army at the city of Nijnei Novgorod, at the confluence of the Occa and Volga. From thence they proceeded down the latter river to the Caspian, and 33,000 men were landed at Dâghestan, on the west side of the sea. He took the city of Derbent from the Persians, and extended his possessions, after which he returned to Astracan in October."

At the south extremity of the Caspian, the bay of Astrabad admits of a secure haven, and may average a week's sail from the opposite port of Astracan. Astrabad is a walled town, having 2 or 3,000 houses; the surrounding country is scarcely surpassed for richness and beauty. At this place a depôt could be formed,and the army assembled for further operations in their progress towards Herat.

*Account of the Kingdom of Cabul, by the Honourable Mountstuart Elphinstone.

*Coxe's Travels in Poland, Russia, &c.

"On the borders of Khorassan, and to the north of Astrabad, is the province of Khaurizm, comprising the country between the Caspian and the Oxus; the wandering tribes breed sheep, camels, and horses; the steppes that border on the Caspian abound in prodigious droves of cattle, and 'there is scarcely a man in Toorkaustaun so indigent as to walk on foot; even beggars travel on horse-back, or at least on asses.'"*

It is stated of those tribes, that 'next to their horses, the most valuable possession of the Toorkaumauns is the camels, of these are bred among them, and generally in Khorassan, three different sorts.'† Individuals are said to have as many as seven hundred camels. They are sold at from 120 to 200 Persian rupees each, and carry from 450 lbs. to 1100 lbs. English.

Towards the end of the last century, a Persian force of 60 or 80,000 men, under Aga Mahomed Khan, proceeded from Astrabad to Mushed. The following particulars of the country between those places are borrowed from an author already quoted,‡ and who visited Mushed in 1821-22. From Astrabad toward Mushed the road for eighty-two miles passes across a rich and verdant district, and ascends a mountain-pass at Goorgaun. A dreary desert, but with water, next extends over a rough country for ninety-two miles to Killa Khan. The road then passes through a fine cultivated country, presenting a highland scene, after which it descends into a valley by a road which carriages might have run, and reaches Sheerwan, a distance of seventy-six miles. Sheerwan is a populous town, the valley in which it is situated is so fertile that it gives credibility to the almost extravagant account of its produce. This valley begins considerably above Sheerwan, from whence the road continues to pass through it for thirty-two miles, and reaches Cochoon, having about 20,000 inhabitants. It is asserted that when the king was at Cochoon, with an army, and its followers of all sorts, amounting to no less than 300,000 souls, with nearly as many head of animals, baggage cattle, including corn and straw, were so plenty, that barley sold at the rate of 20 maunds, (or 140 lbs.) for a rupee, (2s. sterling) and that, in fact, provisions were so abundant in the camp, as hardly to be of any value"§. Passing Cochoon, and continuing 91 miles further in the same valley, the road reaches Mushed, the capital of Persian Khorassan. The whole distance from Astrabad to this place by the above route is 373 miles. "The valley of Mushed is of great length, it may be described as taking its rise ten or twelve miles to the north-west of Sheerwan, and extending almost uninterruptedly for fifty miles beyond Mushed;"—it has a low rocky pass of about four miles, and probably extends greatest part of the way to Herat; it varies in breadth from twelve to thirty miles; it contains in its limits several towns with their dependencies, and a great extent of cultivated land.¶ Mushed is in the dominions of Persia, it is the residence of a prince of the blood, and has about 32,000 inhabitants. The tribes in the vicinity, although of little consequence in regular warfare, are addicted to plunder, and are excellent horsemen; they are armed with spears and swords, or bows and arrows. There is another route from the south of the Caspian to Mushed, through Nishapoor, which reduces the distance to Mushed to less than 300 miles, and passes over a country much like that above described. It is said of this route, "the plains and district of Nishapoor have at all times been celebrated for fertility; when looking from the top of the old ark, (castle) at the numerous villages on either side, and enquiring whether they were all inhabited, I was answered in the affirmative."* When within fifty miles of Mushed, "we enjoyed a very noble view of this fine country, running from south-east by east, to north-west by west, for full eighty miles in length, by fifty to sixty miles in width, and well studded with villages."

* Elphinstone. † Fraser. ‡ Ibid. § Ibid. ¶ Ibid.

We are sorry that our space compels us to break off here: we shall, however, continue our account of this interesting subject in our next.

Art. III—Narrative of a Residence in Koordistan, and on the site of Ancient Nineveh; with Journal of a Voyage down the Tigris to Bagdad, and an Account of a Visit to Shirauz and Persepolis. By the late Claudius James Rich, Esq., *the Hon. East India Company's Resident at Bagdad, Author of "an Account of Ancient Babylon."* 2 *Vols. Octavo.* James Duncan, *Paternoster-Row,* London, 1836.

The editor of the present work is a daughter of that celebrated and lamented individual, Sir James Macintosh; and to give our readers an immediate interest in the work, we shall proceed to give some account of that extraordinary man, Mr. Rich. He was of Bristol. At the age of fourteen, with little or no assistance, he made himself acquainted with many languages, but particularly with those of the east. Besides Latin, Greek, and many of the modern languages, he made himself master of the Hebrew, Chaldee, Persian, Arabic, and was capable of

*Fraser.

deciphering Chinese. This acquaintance with, and study of, eastern languages, induced a vehement desire to proceed to India, and indulge the passion for eastern literature : to be brief, at the age of seventeen he obtained a cadetship. While at the India House the attention of Sir Charles Wilkins was called to young Rich's aquirement in the oriental tongues. Sir Charles was so struck with his extraordinary proficiency, that he pointed him out to the Court of Directors as a young person of singular and rare talents,—one that would amply justify and do honor to any exertion of their patronage. On this representation of Mr. Rich's merits was he presented with a writership by the late Edward Parry, Esq. and appointed to Bombay, and was attached as secretary to Mr. Lock, who was at that time proceeding to Egypt as Consul-General: while on this detached service, his rank, contrary to the usage of the service, was allowed to run on in the same way as if he had repaired to India. Mr. Lock, however, died at Malta before entering on his mission. Mr. Rich, proceeded to Constantinople and afterwards to Smyrna, with the view of making himself thoroughly master of all the niceties and peculiarities of speaking and writing the Turkish language, and of gaining an insight into the nature and extent of the acquirements of the mussulmans in the various branches of learning. He therefore became a fellow student with Turks of his own age. While in Egypt he perfected himself in the Arabic language and its various dialects, and devoted his leisure hours in attaining skill in horsemanship, and in the management of the scimitar and the lance : thus, adding to mildness of manners and studious habits a manly deportment, and lively and sportive wit, he gained the esteem and friendship of the Franks within the circle of his acquaintance. Having attained the object of his visit to this country, and confiding in his knowledge of the Turkish language, he left Egypt in the disguise of a Mameluke, travelled over a great part of Palestine and Syria, visited Damascus, while the great body of pilgrims were assembled there on their way to Mecca, and entered the grand mosque,—an act which at one time would have proved fatal to any one known to be a Christian. His host, an honest Turk, captivated with his address, eagerly intreated him to settle at that place. From Aleppo he proceeded, by Mardin and Bagdad, to Bassora, whence he sailed for Bombay, which he reached in 1807. When here, being introduced by the Rev. Robert Hall, he resided with Sir James Mackintosh. We shall furnish our readers with Sir James's opinion of Mr. Rich, expressed in a letter addressed to a friend.

"You may recollect, perhaps, to have read in the newspapers in 1803, that Mr. Parry, the present chairman, gave a writership here, to a young man of the name of Rich, merely on Mr. Wilkins's report of his extraordinary proficiency in Eastern languages, without interest, and, I believe, without even personal knowledge. He came out as assistant to young Lock, who was appointed Consul at Alexandria ; and, since his death, has travelled over the greater part of Turkish Asia, in various directions, with the eye and pencil of an artist, and with the address and courage of a traveller among barbarians. He acquired such a mastery over the languages and manners of the East, that he personated a Georgian Turk for several weeks at Damascus, amidst several thousand pilgrims, on their way to Mecca, completely unsuspected by the most vigilant and fiercest Mussulman bigotry. He was recommended to me by my friend Robert Hall, and I had several letters from him. I invited him to my house ; and at his arrival on this island, on the 1st of September, 1807, he came to us. He far surpassed our expectations ; and we soon considered his wonderful oriental attainments as the least part of his merit. I found him a fair classical scholar, and capable of speaking and writing French and Italian like the best educated native. With the strongest recommendations of appearance and manner, he joined every elegant accomplishment and every manly exercise ; and combined with them, spirit, pleasantry, and feeling His talents and attainments delighted me so much, that I resolved to make him a philosopher ; I even thought him worthy of being introduced into the Temple of Wisdom, by our friend Dugald Stewart; and when I went to Malabar, I left him at the house of my philosophical friend Erskine, busily engaged with the 'Philosophy of the Human Mind" On my return, I found that this pupil in philosophy was desirous to become my son in law. He has no fortune, nor had he then even an appointment ; but you will not doubt that I willingly consented to his marriage with my eldest daughter, in whom he had the sagacity to discover, and the vir-

tue to value, the plain sense, modesty, purity, and good-nature, which will, I hope, make her a source of happiness to him during life.

"Soon after, the most urgent necessities of the public called for a Resident at Bagdad. He alone was universally acknowledged to be qualified for the station. He was appointed: having thus, twice before he was twenty-four, commanded promotion by mere merit. They were married, and are gone to Bagdad."

At Bagdad, a high spirit, sound political views, a perfect knowledge of the native character, and a profuse generosity, speedily gained him the highest reputation both with the local government and with the people. He resided six years at Bagdad with no European Society save that of his accomplished lady, and of Mr. Hine, the surgeon to the Residency, who was also his assistant. There, however, the leisure hours of Mr. Rich were occupied in making collections for a history, and for a geographical and statistical account, of the Pashalik of Bagdad. He examined all the remains of antiquity within his reach, and commenced his collection of Oriental manuscripts, which he spared no labour or cost to render complete. He formed a rich collection of medals and coins, and of the gems and engraved stones found at Babylon, Nineveh, Ctesiphon, and Bagdad. He made an excursion to Babylon for the purpose of examining the remains of that ancient city.

In 1813 Mr. Rich, on account of ill health, travelled to Constantinople. In 1814 he prolonged his journey through Bulgaria, Wallachia, and Hungary to Vienna, and thence to Paris. Mr. Rich, returning to Bagdad, passed through Switzerland to Milan, thence to Venice. He crossed over to Trieste, whence he proceeded, by Corfu and the Archipelago, to Constantinople, touching at several of the islands, and landing to examine and explore the site of ancient Troy. From Constantinople he returned to Bagdad, through Asia Minor, taking as far as possible a different road from that which he had pursued on his way to Europe, noticing particularly the geography of the country and especially the lying of the chains of mountains; and as he came nearer Mesopotamia, visiting the Syrian and Chaldean convents, and collecting information regarding the singular race of Yezzidis. After his return to the Residency he added so largely to his collection of MSS. as to render it perhaps the most extensive and valuable ever brought together by any private person in the East. In 1820 his state of health requiring again change of air, he made a tour into Koordistan, of which the work under review contains the Journal. On his return he visited the ancient Christian churches of Chaldea, and was enabled to preserve and add to his library many valuable and very ancient Syrian and Chaldean versions of the sacred Scriptures. Mr. Rich also made a tour to Shirauz and visited the ruins of Persepolis, the tomb of Cyrus, and the other remains of antiquity in that neighbourhood. While at Shirauz, the cholera broke out, of which this distinguished individual died on the 5th of October. With the exception of a few communications printed in the Mines de l'Orient the only writings which he published in his lifetime were the Memoirs on Babylon. He has left however a considerable number of manuscripts; in particular an ample journal of his route from Bagdad to Constantionople. His magnificent collection of Oriental MSS. of coins and antiquities, was purchased by the British parliament, for the use of the British Museum. In the work before us the geography of Koordistan and the manners of the inhabitants are placed in a new and strong light, to which we shall advert particularly in our next.

Art. IV.—Observations on the Flora of Courtallum. By ROBERT WIGHT, ESQ. M. D.—*Madras Journal of Literature and Science,* 1836.

Dr. Wight is already well known to most of our readers as a talented and indefatigable labourer in the Science of Botany. The following paper we are about to review is another valuable acquisition to our knowledge of the Botany of India. The paper opens with a description of

CAPPARIDEÆ,

A large and almost exclusively tropical order, a few species only being found in temperate zones, while they every where abound within the tropics: it is divided into two sections; the *Cleomeæ*, or genera with herbaceous stems and capsular fruit, and the *Cappareæ*. The next but small order our author notices is,

FLACOURTIANEÆ;

Most of the species of which are tropical: its essential character is that it has a one-celled ovary with parietal placenta. The flowers vary considerably in different genera, nearly one half of which have flowers without petals; some are dioicous, or monoicous, while *Phoberos* and others have them bisexual. In habit, they are all trees or shrubs, many of them armed with large strong thorns. *Hydnocarpus* bears a fruit poisonous to fishes, on eating which they become unfit for food. The next is a large but principally extra-tropical order:

VIOLARIEÆ.

The species of *Ionidium*, two of which Dr. Wight found at Courtallum, are very widely distributed over India. They are used as a substitute for ipecacuanha.

The next order is,

POLYGALEÆ.

In a botanical point of view our author considers this order interesting, as affording a good example of unsymmetrical flowers. The normal, or regular, form of a flower is to have 5 sepals, 5 petals, and 5, 10, 15, &c. stamens, or the sepals, petals, and stamens, regular multiples of each other. In place of this arrangement in *Polygala* is found a calyx of five sepals, the two lateral ones petaloid, and much larger than the other three (usually called alœ or wings in the generic character); a corolla of three petals, the claws of which are usually united at the base, forming a single tubular three cleft petal, the middle lobe of which is frequently furnished with a crest; and eight stamens united into two bundles. *Xanthophyllum*, except the stamens, returns to the normal form, having five sepals and five distinct petals, but only eight stamens, six of which are opposed to the petals, in place of having ten, the normal number, opposed alternately to the sepals and petals. The roots of several are said to be antidotes to snake bite. *Xanthophyllum virens* is a large timber tree, remarkably hard and useful. The next orders mentioned are,

ELALINEÆ, CARYOPHYLLEÆ, & MALVACEÆ

The last is a large and an important order; from the number and variety of products useful to mankind; as food, clothing, and medicine. Its species are found widely distributed over the tropical and temperate zones, but disappear as we approach the frigid. The uniform character is to abound in mucilage, and to be destitute of unwholesome qualities. The medicinal qualities of marsh mallows are known to everyone: the *Hibiscus subdariffa* is prized as a tart fruit. The *Thespesia Hibiscus populnea* affords an excellent close-grained wood for cart-wheels and gun-stocks. Among the herbaceous *Malvaceæ*, many species produce fine fibres of great tenacity, well fitted, if more care was bestowed on their preparation, to be employed as substitutes for flax and hemp. The *Hibiscus cannabinus* is more cultivated for the hemp-like fibres of its bark than as a pot-herb. The great benefits derived from this shrub need not be enlarged upon. The great demand for cotton, and the millions to whom its culture affords a livelihood by its fabrication into cloth, are well known. This Dr. Wight relates as being applicable to cotton as well as to sugar. He says that the cotton manufacture originated in India upwards of three thousand years ago: from that time to the beginning of the present century she may almost be said to have held the monopoly of this branch of industry; so far as muslins and the finer sorts of cotton fabric are concerned. Our author's views, as regards the improvements introduced by machinery, are worthy of being noticed, as well as his remarks on the

CULTIVATION AND TRADE IN COTTON.

"The Hindoo weaver, skilful, from long practice, in the use of his simple implements and having no competitors, did not think it necessary to tax his ingenuity, for the invention of new and improved spinning and weaving machinery, but went on, as his progenitors had done, spinning and weaving, with a wheel and loom still of the simplest construction.

The process of fabrication, by such primitive methods, is so slow, that a man and his family, in constant employment, can do little more than support themselves by their labour. When, on the contrary, the raw material is exported at heavy cost to Britain, and manufactured there, with the aid of improved machinery, it can be brought back and sold, after paying the expences of a second voyage, from 20 to 30 per cent. under the produce of the same quality of the native loom. Owing to this difference, when the trade was thrown open, and free access was allowed to British manufactures, their cheapness soon drove the Indian ones out of their accustomed markets, and caused at first great distress to our manufacturing population. Now, however, the scales are re-adjusting themselves to our altered circumstances, and the advantages of the change are becoming evident. The exportation of piece goods, from the comparatively small quantity that could be produced for exportation, and the great expence of fabrication, never could return a propoitional, if even a remunerating, profit to the country. The raw material, on the contrary, owing to the unlimited demand, the comparatively high price which it bears, and the small expense of preparing it for the market, not only remunerates, but returns such a profit, as to stimulate to a vastly increased production ; when we add to this, that our growers can now clothe themselves with English cloth more cheaply than they formerly could with native, we can at once appreciate the advantages which India is in course of deriving from the English cotton manufactories ; and how much her future prosperity must depend on the extension and improvement of her cotton cultivation. The fulfilling of these conditions is, in truth, indispensable to a continuance of that commercial prosperity, which is now beginning to dawn on us ; since, unless we labour diligently to improve the quality, and diminish the exportation price of our cotton, great as the demand now assuredly is, we can scarcely expect that it will be able to hold its present place in the English market, when opposed by so many competitors, and, still more, by the long and expensive voyage required to bring it into that market.

This is not the place to enter on the description of the methods of cultivation, but I may mention, generally, that the soil of much of the Peninsula is well suited for raising some of the finer kinds of foreign cotton, such as the Bourbon and American green seed cottons. Those soils in which the former thrives best, at least in the Tinnevelly district, are light, loose, and sandy, of a deep rusty red colour, and largely impregnated with iron ; for the latter, dark soils, of a loose and friable description, from containing a considerable admixture of sand, and that have formerly been under wet cultivation. To do the plants justice these should be ploughed with a deeper furrow than is usual in Hindoo agriculture, to allow of free access to the depth of at least a foot to a large descending, or *tap,* root with which it is furnished. The sowings are generally commenced near the end of the rains; it would be better if they were done earlier, to allow the plants time to attain nearly their full size, before the hot dry season set in. This is of consequence, because it is the check which it then receives, that determines to the formation of flower buds, which, by being delayed till this more advanced stage, would probably be productive of larger crops and better cotton. Cropping the ends of the young shoots, at this time, would still further lead to the same effect ; by stopping the too rapid flow of the sap, and favouring the concentration of the secretions, and thereby the formation of flowers and fruit. I mentioned, at the conclusion of my last paper, the tendency of extreme luxuriancy of vegetation to cause sterility. This is frequently the case with cotton ; hence the almost constant failure of attempts to cultivate Bourbon and American cottons, on what is called the *black cotton soil*, its extreme fertility causing them to run to wood and leaves, and produce no flowers. So different is the indigenous Indian cotton, in this respect, that on the red soils it gives both inferior crops, and cotton inferior quality, and attains its greatest perfection on the black. Pruning the extremities of the young branches, is extensively practised in some countries where the plant has been long and very successfully cultivated. Some practical writers however object to this practice, they say, as the result of experience ; but, as the experiments made to prove this position are not detailed with sufficient exactitude, to enable me to determine their value, by an examination of the circumstances that might have an unfavourable effect on the result, and as they are at variance with the principle of vegetable physiology, I feel disposed to doubt their accuracy. As this is a practical question of great importance, and one which can only be set at rest by a series of carefully conducted experiments, I must, for the present, leave it in the hands of those who enjoy opportunities of examining it in that manner, and shall feel much indebted to any one who can give me practical information, on this, or on any other, point connected with the cultivation of cotton.

I have been induced to enter, thus largely, on the consideration of subjects connected with the cotton trade, for the sake of showing the advantages India is already reaping from her, as yet comparatively limited, engagement in this branch of commerce, and of calling attention to the much greater ones she may expect to flow from it, as the rewards of industry and attention to increase the quantity, and improve the staple, of the article which forms its basis, in the hope of inducing practical men to lay the results of their experience before the public, for the guidance of their less informed neighbours. As there are but few Europeans engaged in this culture, I more especially address myself to intelligent and well informed natives, many of whom are readers of this Journal, and, among whom, I feel assured, there are many, both able and willing, to furnish much really useful information, acquired during a series of years devoted to agricultural pursuits, but who are kept back, either by supposing that they have nothing new to communicate, or from a distrust

in their qualifications to reduce, to a suitable form for publication, the results of their experience. To all such, the writer of these memorand offers his assistance, and, in the hope of more rapidly extending our knowledge of cotton culture, as well as forwarding the wishes of government in the improvement of our commerce, will, with pleasure, charge himself with the task of correcting for publication, all really practical communications that may be addressed to him.

The following are some of the points on which information is wanted:—What is the depth to which the soil should be turned, by ploughing or digging, for cotton cultivation? What are the advantages or disadvantages of sowing in rows as compared with broad cast? Would sowing during the earlier periods of the rainy season, be productive of larger crops, or improve the staple of the cotton? What are the effects of cropping the top shoots about the time of flowering? In Spain, and the Islands of the Mediterranean, where cotton has been long cultivated, and generally in America, the ground is turned to the depth of ten or twelve inches or more, in this country, rarely to half that depth. In these countries the row system is usually adopted, and a regular interchange of seed practised, it being observed, that the crops deteriorate both in quantity and quality, when this is neglected. In this country both practices are almost unknown. The question of the best time for sowing is a local one of season, and must be determined by comparative trials, made in the same field, and on plants placed, in every other respect, in the same circumstances. That of cropping must, in like manner, be determined by comparative experiments on plants placed, in every respect, in similar circumstances. With respect to this operation, I may repeat that, as the object of it is to retard the two rapid flow of the sap, and favour the concentration of the secretions on which the formation of flowers and fruit depends, it is essential to its success, that it be done in very dry weather, and on clear days (exposure to bright sunshine prevents bleeding); consequently the state of the weather should be noted, in connection with details of experiments illustrative of this branch of the enquiry."

This is a valuable paper, and we shall refer to it again.

Art. V.—On the employment of the Electro-Magnet as a moving power: with a description of a model machine worked by this agent. By W. B. O'Shaughnessy, M. D.—*Quarterly Journal of the Calcutta Medical and Physical Society, January,* 1837.

We have already alluded to the production of motion by magneto-electricity, and to mechanical contrivances by which a body might be made to move continuously by magneto-electric agency, and to the contrivance of Dr. O'Shaughnessy exhibited at the Government House in November last; the results of which our zealous professor has published, strange to say, in a work that will be read but by few. To rescue the meritorious exertions of our friend from being buried in oblivion, and to spread far and wide every invention tending to promote useful and important results, we shall again curtail other reviews this month in order to give the paper in full.

"In the present and a succeeding paper I propose to give an account of some experiments I recently instituted with the view to apply the force of the Electro-Magnet as a practical working power. As there are several members of the Society to whom electro-magnetic phenomena are but little familiar, I will in the first place briefly touch on such of the facts previously established in this science, as are essential to the comprehension of the experiments and models I shall subsequently describe.

The leading fact connected with the present object, is the magnetic effect produced by electricity in motion through galvanic conductors. Let a plate of copper and another of zinc, not touching each other, be immersed in water acidulated with sulphuric or nitric acid, and then let a wire be made to touch both plates out of the fluid: the wire becomes magnetic itself, and, if placed at right angles to a bar of iron, renders the iron a magnet also. If the wire be removed from either plate, the electric circuit being thus broken, the magnetic effects instantaneously cease, and both wire and iron regain their original neutrality. In conformity with this principle, if we take a copper wire covered with silk, and wind it in a close spiral coil round a bar of soft iron, and then bring each end of the wire into contact with the copper and zinc plates, the galvanic current flows at right angles to the bar through the spiral coil, (the covering of silk preventing any lateral communication) and the bar becomes a powerful magnet. If swung so as to move freely it places itself in the magnetic meridian N. and S. Its ends are strongly polar, N and S. respectively: it attracts iron and the dissimilar poles of other magnets with great power. If instead of using a bar we employ a piece of iron bent like a horseshoe, with the terminating surfaces ground and polished, a powerful magnet is obtained, which will support a great weight, while the spiral is traversed by the galvanic current. Several very powerful temporary or electro-magnets of this kind, have been constructed by various experimentalists. The most remarkable is that made in America at the Albany College, which supported nearly a ton weight. Mr. Marsh of Woolwich has one the legs of which are but six inches long by one and a half square, which supports 500 lbs.

The next remarkable property of these soft iron electro-magnets is, the instantaneous change of their poles on changing the direction of the galvanic current. If the ends of the spiral in contact with the galvanic plates be made to change places, that which was originally in contact with the zinc being brought to the copper, and vice versâ, the poles of the temporary magnet are changed on the instant too: that which was *north* becoming *south*, that which was *south* becoming *north*. Though itself is not quicker than the velocity with which this change is accomplished, even in the largest bars of iron which have yet been made the subject of experiment.

These facts are well known to all students in physical science. They have been established for some years, and are mentioned here but in connexion with ulterior matters. On observing and reflecting on them, it is impossible to avoid the impression, that, by appropriate mechanical contrivances, this enormous and easily generated power could be made available as a mechanical force. But the difficulties which beset the attempt are many and important. In the first place, though the sustaining power of the electro-magnet be immense, the force operates through such a small distance, that the magnet which would hold up *one hundred pounds*, would not *lift one pound* at the distance of two inches—nay, at one inch. Here it is true we have the magnetic attraction in antagonism with the attraction of gravitation, and it is but the difference of the two forces which the electro-magnet is exerting; nevertheless, even when we exclude this counteracting force, as in arrangements afterwards to be described, the space through which the electro-magnet attracts is very limited, and varies according to the object on which its attraction is exerted. Thus with soft iron the distance is exceedingly minute; the poles of another electro-magnet are drawn from a greater distance; and the poles of a permanent steel magnet through greater still.

The second obstacle we encounter is so well described by Mr. M'Gauley in his paper published in the Appendix*, that I shall advert to it but briefly here. It is the power which the poles of a strong electro-magnet have of superseding the polarity of a weaker one. Thus, if we place the poles of a horse-shoe electro-magnet *in contact* with those of a weaker one, so that north is opposed to south respectively—if we change the poles of the strong magnet by reversing the direction of its exciting galvanic current, instead of the strong repelling the weak, it continues to attract the poles of the weak—these having, in fact, been reversed by the mere change of the strong one alone.

To overcome these difficulties, and to procure a machine moved by soft iron electro-magnets, several attempts have recently been made. I have collected and inserted in the Appendix every notice I could find on the subject. Of these Mr. M'Gauley's contrivance of the magnetic pendulum is infinitely the best: that of Signor Botto being on the same principle, but much less skilfully arranged*. The American model† is so obscurely noticed, and the paragraph relating to it so very like a wild newspaper exaggeration, that it is impossible to form any precise idea as to its construction, its advantages, or its power. For Mr. M'Gauley's model I may refer to his own clear and accurate description. Its chief defect is the mode in which the power is applied. Though the pendulum moves through a wide arc, still it is acting merely as a pendulum through the whole of its vibration, except in the very small space, where the magnetic attraction is exercised. The force acquired by the pendulum in falling through half its arc, is necessarily expended in lifting it through the other half. In the whole of the intervening space, then, between the limits of the magnetic attractions at either side, no available force is in existence. Again, the motion, being a reciprocating one, has to be converted by a crank and a fly wheel into the rotatory one required for locomotive engines. Thus a great expenditure of force is occasioned, which, as I shall presently shew, may be economized by a different mechanical arrangement.

On commencing my experiments in July last, my principal object was, if possible, to apply the force *directly* to the moving of a wheel. Could this be accomplished, it seemed to me that we would use the whole of the magnetic force, unopposed by terrestrial gravitation—that we would act at the greatest possible mechanical or lever advantage—and that should one wheel succeed, a series might be so arranged together, that the maximum of several forces might be made to co-operate, so as to render a number of the small spaced magnetic powers (say 12 powers at half an inch), equivalent to *one* power acting uniformly through the whole space, say six inches.

The first set of experiments was instituted for the determination of the circumstances under which the poles of one electro-magnet overpower those of a second. A pair of semicircular bars of equal size were provided, wound with spirals, each spiral connected with a separate galvanic battery, and the attracting poles of the semi-circles brought into contact: *See fig.* 1.

On changing the poles of B, by moving the ends of the spiral wire from the copper to the zinc element and vice versâ, the poles of the magnet A were overpowered and changed also, *without disturbing their wires*, so that the semi-circles continued to attract each other as before. Now in this experiment all circumstances connected with the two semicircles were as equal as possible. The batteries were of the same size and same strength, bars of the same weight and dimensions, cut of the same piece of iron, the spirals were of the same length, &c., still the magnet B overcame the poles of A. By reversing the experiment, that is, removing the wires of A

* Vide our Review, page 335.

* Vide our Review, page 337.
† Vide our Review, page 401.

instead of B, still the same effect was produced. I was for some time altogether unable to account for this occurrence, but deeming it likely that the momentary interruption of the circuit, caused by moving the wires, might have enabled the electricity to accumulate and act with greater inducing energy on the restoration of the circuit, additional experiments were made which justified this view of the subject.

If, when the pole wires of A were mechanically changed, the circuit was broken in B, by removing one of the wires for an instant from its plate, and then replacing it, both galvanic currents then acting with equal energy, the magnets held their respective polarities: no overpowering took place, and A ceased to attract B, which accordingly was repelled. I should observe, that mechanical supports and guides were used in the experiment, which I have not delineated in the diagram.

This fact of the increase of *magnetic* energy given by interrupting the circuit, is one of much practical moment. It is a necessary consequence of the restoration of *electric intensity*, brought about by the breaking of the circuit which Marianini described in 1828, in his paper in the 38th vol. of the *Annales de Chemie*. I am not aware that the effect of this renovation of power on the *electro-magnet* has been previously studied. It is well exemplified by an experiment which may be readily performed. If we excite an electro-magnet by a battery of 10 pairs of Wollaston plates, 100 water, 2 sulphuric, and 1 nitric acid, by carefully but rapidly loading the magnet, we find its maximum sustaining power, say 20 lbs.; add another pound, and the keeper and weights fall off. If we now attempt to load the magnet again, we find it will not support more than half its previous charge. But if we remove one of the wires for a moment from the circuit and then replace it, the magnet will then sustain the same weight as at first. Or we may take the experiment under another modification. Load the electro-magnet with its known maximum weight, say 20 lbs., and allow the action to proceed till the weakening energy of the battery allows the weight to fall spontaneously; try to replace it on the instant; the electro-magnet will seldom support as much as 5 lbs.; but if we interrupt the circuit for a moment, it will support 18 or even 19 lbs., and allowing the successive charges to fall, and repeating the experiment, we find the magnetic force sink gradually to zero as the force of the galvanic action declines.

To revert to the overpowering of the poles in the instances above mentioned, further experiments shewed that this action only occurred when the metallic surfaces of the bars were actually in contact, and that the interposition of even one leaf of paper glued on the polar surfaces prevented the effect in question.

The practical applications of these facts in the construction of machinery to be worked by electro-magnet, will be sufficiently obvious in the sequel of this paper, and on perusal of Mr. M'Gauley's article in the Appendix*. Another and an interesting question presented itself before any wheel model could be constructed; viz.—whether, on the excitement of more than one electro-magnet by *the same galvanic battery*, the magnetic force was divided in any definite proportion between them.

The apparatus, No. 2, delineated in the plate, was employed to decide this question. It consists of a small wooden table-shaped frame, on which several small electro-magnets may be placed, so that ends of the spirals of one or more may be dipped into little cups of mercury and removed at pleasure, without disturbing the general arrangement. One of the set is placed with its legs vertically, so that a keeper, scale, and weights can be attached to it.

The experiments were made with 12 small horse-shoe electro-magnets, two inches long, half inch diameter, one inch interval between the poles, and each wound with an equal length of silk covered wire. The battery employed was ten 4-inch plates of Wollaston's construction—exciting liquid, as in all these experiments, 100 water, 2 sulphuric, 1 nitric acid. On exciting the trial magnet or No. 1, it supported 8 lbs. 4 oz. The wires of No. 2 were introduced, and No. 1 then supported but 4 lbs. 3 oz. Three were excited in the same way, and the weight supported was 2 lbs. 10 oz. When four were excited, No. 1 held up 2 lbs. 2 oz. With five, 1 lb. 6 oz. The numbers continued falling by the successive partition of the excitement, very nearly in a direct arithmetical subdivision. When all twelve were in connexion with the battery, the trial magnet sustained but six ounces. In all these experiments attention was invariably paid to breaking the circuit on each fall of the weights, in conformity with the experiments above described. On completing the series of 12, the first experiment on No. 1 by itself was always repeated, in order to ascertain how much of the decrease of power might be attributable to loss of power in the battery. With the proportion of acids, above described, the action is so constant and gentle that the weight first sustained by No. 1 was easily supported again.

This experiment was tried repeatedly, and always with the same results. It shews that the electric force, when *thus* arithmetically subdivided, induces a directly proportionate and less degree of magnetic power.

Having thus given a brief exposition of the electro-magnetic facts, essential to be understood as a clue to the formation of an electro-magnetic engine or machine, I proceed to describe the model I have constructed, such as it was exhibited at Lord Auckland's soirée on the 9th of November.

It consists essentially of the following parts.

1st, THE WHEEL,

Of which the frame is made of light wooden disks, eight inches in diameter, two and half inches interval at the circumference between the disks, which are fastened on a concentric wooden support, and mounted on a steel axle half an inch in diameter. Around this wheel, at intervals of two

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* Vide our Review, page 335.

inches, are disposed twelve small horse-shoe electro-magnets of the dimensions already described. One end of each spiral (see fig. 3) is soldered to a disk of copper, *c*, one inch in diameter placed on the axle concentric with the wheel, and revolving in a little cup of mercury *m*, connected by a wire with one pole of a galvanic battery. The other ends of the spirals are arranged on a small ivory disk, so that the ends of *three* dip in a similar cup of mercury, one always rising from, as the third enters, the surface of the mercury in connexion with the other pole of the battery, as is readily seen in the fig. 6. The wires on this, the interrupted disk, are further so arranged by gently twisting their continuations towards the wheel, that the wire of the magnet which is horizontal when the wheel is at rest, is perpendicular to and beneath the surface of the mercury. A glance at the figures 3, 4, 5, and 6 will make this description readily intelligible.

Let us now suppose this wheel mounted on proper supports, and conductors from a galvanic battery brought into contact with the wires leading to the mercurial cisterns belonging to the wheel. If the wheel be made to turn, the smaller copper disk revolves in the mercury continually, and hence *all* the wheel irons are *ready to be* excited on completing the galvanic circuit. This is effected for *two* by the interrupted disk revolving in the other cistern, so that of the twelve irons, *two* are always rendered electro-magnets in succession as the wheel turns, as shewn in fig. 7. Whenever the bent iron descends to the angle of 30° above the horizon, it becomes magnetic; its second wire then touching the surface of the mercurial cistern at an acute angle. When horizontal it is still magnetic, its second wire being then perpendicular to and in the cistern. When at an angle of 30° below the horizon, the wire then emerges from the mercury, and the iron loses all magnetic power. Thus, in the revolving wheel, two magnets are always excited, their poles being in alternate order, and the magnetism of each only exists while the bent iron is passing from 30° above to 30° below the horizon. The alternate order of the poles is ensured by the ends of the spirals of each magnet being alternately crossed, so that the successive poles at the same side are in contact alternately with the zinc and copper ends of the battery, (see figures 3, 4, and 5.)

The next essential part is

THE EXTERNAL OR PRINCIPAL ELECTRO-MAGNET.

It consists of a bar of soft iron, bent so that the legs are parallel to each other at the distance of two inches. The legs of the bar employed in my first experiment, were but three inches long, ⅝ in diameter. It was wound with a double spiral in the usual manner. Its sustaining force, when excited by a ten-plate 4-inch Wollaston's battery, averaged 30 lbs. It weighed with its spirals complete, 11 Troy ounces.

This electro magnet was placed horizontally on a wooden support—its legs on the same plane with, and close to, but not touching, the presenting legs of the horizontal wheel magnet. The ends of the spirals from this electro-magnet, were led to cups containing mercury, in connexion with the poles of a galvanic battery, through a moveable system of conductors, devised so that the revolution of the wheel changes the poles of the external magnet every time that one of the wheel-magnets becomes horizontal, (see fig. 7.) This part of the model I shall next describe; I term it simply

THE POLE-CHANGER;

and its construction is illustrated in the figs. 8, 9, 10, and 11.

The object of this contrivance is, to lead the current of electricity alternately to the right and left side or leg of the principal external magnet. We accomplish this by guiding the current diagonally (see fig. 10) in one instant, and making it return diagonally, so that its course from the battery and its return are exemplified by an 8 figure. In the second instant, fig. 11, the current proceeds directly to the opposite leg of the principal magnet, and returns as directly at the other side; its course resembling the letter O.

Twelve circular holes, each half an inch in diameter, and half an inch in depth, are cut in a piece of wood at one inch distance from each other, as shewn in the figure, and fixed wires are led from cavity to cavity; so that 1, 2, 3 are at right angles to, and in metallic connexion with, each other. In 3, 4, 5 the same occurs, and so with the remaining numbers, as may be seen in the plate (figs. 10 and 11.) Glass tubes two inches in depth are cemented into the cavities in the wood, and about ⅝ of an inch of mercury poured into each tube. Now by leading a silk covered wire from 2 to 8, and another from 5 to 11, it is obvious we make the galvanic current flow from 1 to 2, cross to 8, circulate round the magnet at 7, return from 5 to 11, and reach the battery again at 12, rendering *a* a north, and *b* a south pole. If then we remove these diagonal wires and insert wires from 3 to 4 and from 9 to 10, (see fig. 11,) the current takes exactly the different direction: instead of proceeding to *a*, it goes to *b*, which instead of a south becomes a north pole.

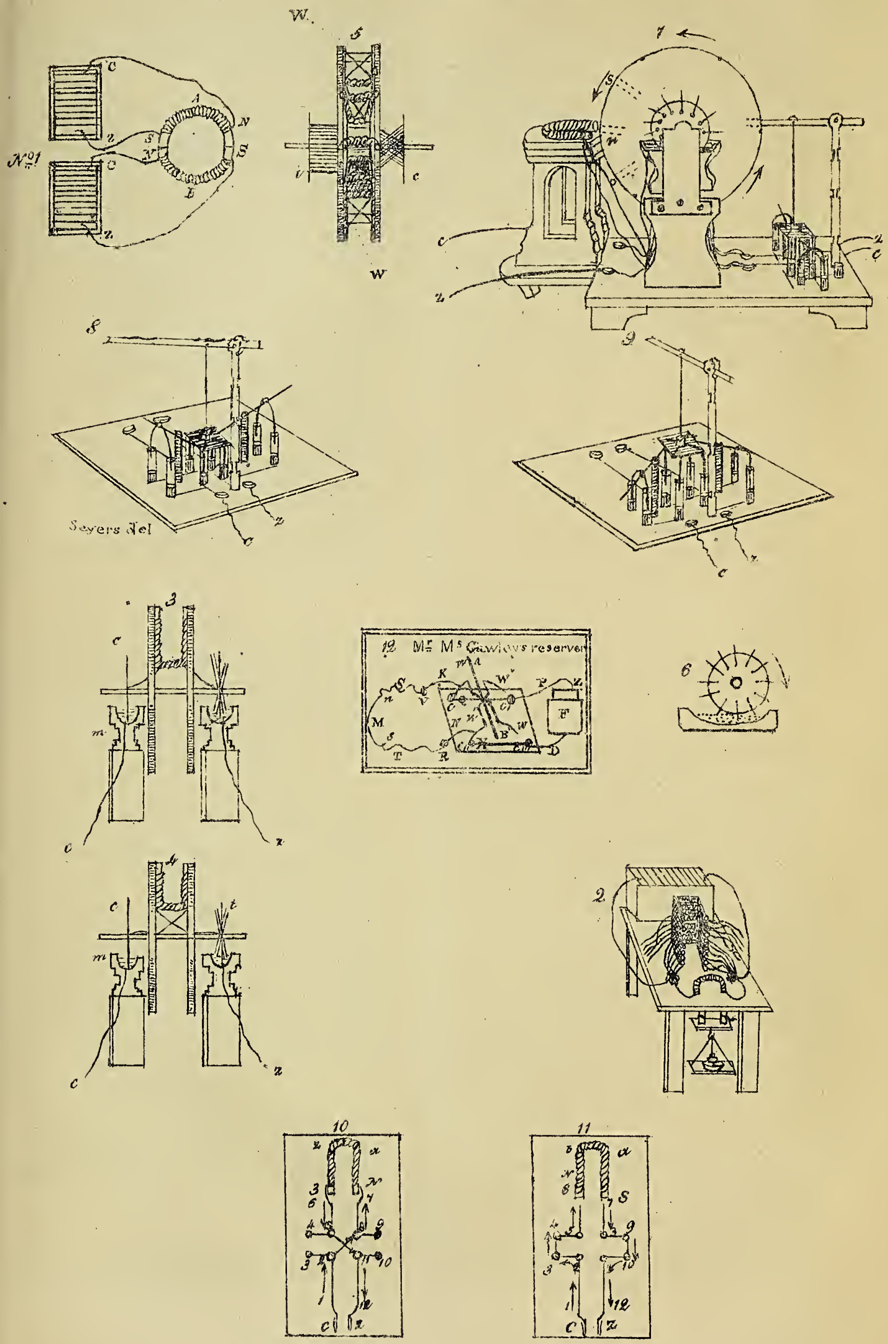
These connecting wires are accordingly so arranged with a set of levers made of slender wood, that when the lifting of the horizontal long lever, shewn in the drawing, causes the diagonal wires or drawbridge to rise from the mercury, the direct or lateral wires fall in at the same moment; the current instantaneously changes: and again, when the long horizontal lever escapes the lifter I shall presently describe, the diagonal wires fall into the mercury, and a small square slip of ivory on which these wires are fastened strikes the ends of the little lateral levers, and causes their wires to leave the mercury and break the lateral communication.

The lifting and falling of the long horizontal lever is effected by six wires placed parallel to the axle, half an inch within the circumference of the wheel, and immediately across the legs of each alternate wheel-magnet; see fig. 5, *w. w.* By this arrangement the poles of the principal *external* magnet *change* every time that one of the twelve wheel-magnets becomes horizontal.

Let us then suppose these several parts placed on a frame, as shewn in the chief drawing, and the wheels and external magnet excited each by a Wollaston battery of ten-plates. The wheel is at rest; communication through the pole-changer diagonal: the right side of the external magnet has, we will suppose, a north pole, and the wheel-magnet at the corresponding side at an angle of 30° above the horizon has a south pole (and vice versâ at the opposite side). The external magnet forcibly attracts the internal one, which descends to the horizontal plane. At this moment the wire on the circumference of the wheel, acting on the long lever of the pole-changer, lifts the diagonal wires, and permits the lateral to fall; the poles of the external magnet change: they repel those of the internal or wheel-magnet, which they had just before attracted, and they attract the next wheel-magnet exactly in the same manner, owing to the alternating arrangement of the wheel-magnets previously described. When this, the next wheel-magnet, becomes horizontal, the long lever of the changer falls, the diagonal communication is restored, the lateral interrupted, and the poles of the external magnet again changed. Thus the external magnet changes its poles every time an internal magnet presents; and as the change makes the opposite and horizontal magnets repellent, and the external and upper wheel-magnet attractive, rapid rotation forthwith ensues.

The model thus constructed was finished on the 5th October, and immediately tried: and on the first attempt it more than fulfilled my anticipations. The moment the batteries were connected

Plate 1



with the magnets*, the wheel started off, and from the first movement worked the pole-changer with ease. The velocity with which it revolved was very considerable—namely, 40 revolutions in a minute; and this velocity was perfectly uniform as long as the galvanic excitement was sustained. The force was so great that the support of the external magnet was repeatedly dragged inwards to the wheel, and the magnets came in contact with a stroke that made the frame vibrate, to obviate this we were obliged to fit in another very strong support.

Several experiments were subsequently made with this model, as well to determine its actual working power, as to obtain the necessary data for the construction of a larger machine.

A cord was attached to the axle, made to play over a pulley half an inch in diameter, and connected with a scale. On starting the model, the axle lifted 10 troy ounces while the wheel was revolving forty times, and a troy pound while revolving about thirty times per minute.

These experiments were made, the wheel being excited by one of Wollaston's ten-plate 4-inch troughs, the external magnet by another trough precisely similar. On adding a second trough to the external magnet, the velocity became so rapid we could with difficulty count it by the eye. The velocity was similarly increased by adding the second trough to the wheel instead of the external magnet. The speed of the wheel was also remarkably increased, by connecting with the battery the second spiral with which the external magnet was provided. It is almost needless to mention that the machine was stopped at pleasure by removing any one of the connecting wires, whether of the wheel or of the external magnet. In this state the model was shewn to several friends, and afterwards exhibited at Lord Auckland's conversazioné on the 9th of November.

Remarks.

The preceding description and drawings, together with the papers I may refer to in the Appendix, are quite sufficient to shew that the mechanism of this model is altogether different from that of any electro-magnetic machine hitherto invented, of which any account has been published.

The pole-changer described by Mr. M'Gauley is in *principle* the same as mine; and had I received that gentleman's paper when I commenced my experiments, I should not have deemed it necessary to construct a different one. My model was, however, finished and shown at Government House before I received the Philosophical Magazine containing the description in question. In all respects, however, the details of these pole changers differ. The mode of working the wires is peculiar to mine, and the glass tubes in mine serve the important end of guiding the wires to the mercurial surface, and preserving this from accidental derangement by the motion of the machine.

The application of electro-magnets to the direct attainment of a rotatory motion being thus accomplished, and all intervening and weakening impediments of cranks, &c. altogether avoided, the question of course presents itself, Can this motion be rendered sufficiently powerful? and if so, can it be procured at so economical a rate as to justify the expectation that it may be made available as a mechanical or locomotive agent?

It is but with the utmost self-distrust that I would venture to discuss the first of these questions, since I cannot but be conscious that my knowledge of mechanics is too limited to warrant my speculating on the subject but with the greatest caution. But I may perhaps be permitted to offer a few practical observations, in connexion with numerous experiments I have made and am still pursuing.

Apparently the most obvious mode of increasing the power of the wheel would be by enlarging its diameter, preserving the same distance, two inches, between the wheel magnets—by increasing at the same time the number of the wheel magnet, and diminishing the distance between each pair, say to one inch.

A model was constructed with the view to determine experimentally the effect of these alterations. The wheel was $37\frac{1}{2}$ inches in circumference, mounted with 32 magnets; clear interval one inch. The arrangement of the disks, external magnet, and pole-changer, the same as before;—a uniform but extremely slow rotation ensued; the power at the axle was very nearly the same as with the original model. Every alternate magnet was now removed, thus making the interval the same as in the first model; the rotation became equally rapid, but the axle not more powerful than in the 12 magnet 8 inch machine.

The same wheel was then fitted to a frame and series of supports, by means of which *four* external magnets, each of 30 lbs. power, with separate pole-changers, were brought to act *simultaneously* on four sets of excited wheel magnets—viz. one set at each quarter of the wheel. The experiments with this model were satisfactory but inconclusive. Each external magnet increased the power apparently in an arithmetical ratio; but having no more than five sets of Wollaston's plates at my disposal, I was unable to give the wheel magnets the fair quantity of excitement which in the commencement of this paper I have shewn them to require. I have little doubt that when sets of plates now in construction are completed, this form of model will work with four times the power of the first one,—or, in other words, lift 4 lbs. troy at its axle, the wheel revolving forty times per minute.

A third model, on a different plan of combination, is now in construction. It consists of four vertical wheels, of the same dimensions as that in the first model,—all on one axle, and each wheel having an external principal magnet and separate pole-changer. The wheels and external magnets are so set that

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* Only one of the spirals of the external magnet was used in the first experiment.

the maximum forces are exerted in succession from right to left, at an interval of half an inch and in an ascending plane. Thus the two inch distance or interval between the magnets is (with reference to the entire series of wheels considered as a revolving cylinder or drum) reduced practically to a half inch—or, in other words, if a diagonal line be drawn from the magnet in the horizontal plane on the right, to that 30 degrees above the horizon on the left, in each ascending half inch of this diagonal there is a magnet constantly exerting its maximum power.

From this arrangement I anticipate the most favorable results. I see no reason why it should not answer. Should it prove successful, the applicability of the electro-magnet as a locomotive working power will cease to be a matter of speculation.

The application of this power to locomotive engines on railroads is the first which I anticipate. The recent treatise on locomotive machines by the Chevalier de Pambour makes me speak with some confidence on this point. His admirable investigations on the theory and working force of the carriages on the Manchester and Darlington railways, shews that the power necessary for the pulling of one ton at the average is actually only $7\frac{1}{2}$ lbs!—that is, that a weight of seven pounds suspended over a pulley by a cord attached to the carriage will draw the ton weight on a level railway. My first model is by experiment proved to possess one-seventh of this power—or, in other words, to have a tractive force sufficient to move more than 300 lbs. Now the weight of the model itself was but 12 lbs. its batteries 60; and trivial as is this weight, there are numerous facts which shew that it may be very much reduced. *The magnets may be all hollow* for instance, as I inferred from Mr. Barlow's experiments and verified by my own, on magnets made from gun barrels. Again, the most powerful of the electro-magnets hitherto made, viz. the American one, which supported a ton, only weighed 27 lbs.

Numerous facts, too, seem to indicate that the size of the galvanic battery may be reduced to very insignificant dimensions. The magnet now exhibiting in the Adelaide Gallery in London, and which sustains 300 lbs. weight, is rendered active by a set of plates which fit in a pint vessel; and one belonging to Mr. Marsh of Woolwich, which supports 500 lbs. is excited by a battery contained in a half pint mug. Professor Möll of Utrecht has made a 200 lbs. magnet, which has only a single galvanic disk one inch in diameter. These facts are extremely encouraging, though their applications to the object now in view can only be made with great caution. At first sight, it might naturally appear that the sustaining power of a magnet would be a just measure of its available force; but I have found by repeated trials that very good sustaining magnets may be inferior in moving influence to magnets of far less sustaining attraction. I have found with my models that the longer the distance from which an electro-magnet attracts a small piece of steel, the better is its working power; and in partial conformity with facts recently announced by Professor Ritchie, I have found that the length of the attracting distance is increased by prolonging the legs of the electro-magnet. But this only holds good within narrow limits. I had, for instance, three magnets made from one bar of iron. No. 1 was three inches; 2, ten inches; 3, three feet long,—all were wound with single spirals, and each excited by one Wollaston's trough. The magnet No. 2 far exceeded all the others in distant attractive power.

The appropriate batteries for these experiments, and some economical considerations as to the consumption of acid, zinc, &c., require to be cursorily noticed before I can conclude this paper.

When I commenced these experiments I was impressed with the idea derived from the books I had consulted on the subject, that a single pair of copper and zinc plates of moderately large size were the best suited for the production of electro-magnetic forces. I soon, however, found ample reason to alter my opinion. I have made most extensive trials of a great number of batteries of different kinds, and with the results I shall presently detail,—premising, that the same kind of acid was used in each.

The principal batteries tried were—

1. Sturgeon's concentric copper and zinc cylinders, so much esteemed as magnetic exciters.

2. A fine single plate cell, belonging to Mr. Prinsep. $1\frac{1}{2}$ feet wide, by 2 feet long.

3. An excellent pile of 100 3 inch plates, belonging to the Medical College.

4 A Cruickshank's fifty-plate 3-inch trough.

5. Ditto, ten plate 4-inch troughs in porcelain cells.

6. Wollaston's ten-plate 4-inch troughs, double coppers.

7. Six of Professor Faraday's recently constructed plates; see Philosophical Transactions for 1834.

8. Professor Daniel's new battery of cans and zinc cylinders, with animal membrane interposed, with sulphate of copper solution and dilute sulphuric acid.

9. A modification of the above of my own construction, in progressive sizes of 1, 2, 3, &c. to 20 square inches of copper surface, the zinc cylinders amalgamated.

10. A large spiral of ten feet of copper by two feet, wound round a plate of rolled zinc.

11. A Wollaston's double plate, four inches square.

12. A small spiral, 12 inches by 2, of annealed copper and sheet lead

13. A Wollaston's plate one inch and half long by one broad.

The effects of all these batteries were observed on the same electro-magnet——viz., that used as the external magnet in the first model.

EFFECTS.

No.	Weight sustained.	For what time.	Attracting distance.
1.	2 lbs.	15 minutes.	small.
2.	15 lbs.	2 or 3 minutes.	small.
3.	none.		
4.	none.		
5.	none.		
6.	38	2 hours.	great.
7.	9	15 minutes.	small.
8.	25	nearly 3 hours.	small.
9.	Experiments not yet completed, but satisfactory.		
10.	No effect.		
11.	18 lbs.	3½ hours.	moderate.
12.	10 lbs.	3¼ hours.	long.
13.	9 lbs.	Until Zinc dissolved.	long.

These experiments were repeated with corresponding results on electro-magnets of every variety of shape, and weighing from half an ounce to 18 lbs.

Combinations of several of the previous batteries were also tried. The Cruickshank's troughs and cells, multiplied to any number, were invariably useless. But Daniel's cans and Wollaston's double plates gave very different results. Thus, though one Wollaston plate supports 13 lbs., ten of these plates support 38, and twenty plates 47 lbs. There are, I may mention, two modes by which these batteries may be associated, as is well known of course to all experimentalists in this department of science. One is the *chemical*, where the batteries are arranged end to end, the terminal copper plate of one being connected with the zinc of the next. The second is the *magnetic*, in which the troughs are placed side by side, and the final copper cells and zinc cells connected with the cells of the same name.

Numerous experiments were made to ascertain whether doubling, tripling, or quadrupling the number of troughs in either of these arrangements gave a proportionate increase to the magnetic force imparted to the soft iron. The most conclusive of these trials was made with the apparatus previously described, (see fig. 2) While in the chemical arrangement the successive additions made but a trifling increment to the sustaining power, the second or magnetic arrangement gave very nearly a direct increase for every additional battery.

The copper and lead arrangement No. 12 was formed for the purpose of regaining from the solution the materials employed in the excitement of the galvanic action. The experiment answered so well that I mean to have a battery constructed on this principle, by which I have no doubt I can recover a very great proportion of the acid and lead used, because the nitrate of lead formed, yields its acid at a red heat, and the metal is readily recovered by smelting the residue with charcoal.

On the whole, as far as my experiments have proceeded, they shew that, contrary to what is stated by all authorities on this subject, "*quantity*" of electricity (that amount set in motion by a single pair of plates) is not the sole influence required for the induction of great magnetic power. "Intensity," or the impetus given to quantity by increasing the number of plates, within certain limits seems equally, if not more, essential. Intensity adds to the sustaining power, and, I find by many experiments, increases the attractive distance. Nay more :—in almost direct contradiction to what has been stated by writers on this subject, I have reason to believe we may diminish the size of the plates even to one square inch of surface, provided we associated a number of these plates, as in Wollaston's arrangement. But the details on these curious points I must reserve for another paper.

With respect to the economy of the materials used, I may refer to Mr. M'Gauley's interesting observations in the Appendix. In corroboration of his views I may state, that sulphuric acid is now sold in England for one penny the pound ; at which rate, and at the present cost of zinc, I would work my model, lifting a pound weight for twelve hours, for about one shilling. Should we succeed in constructing locomotive engines on the plan I have attempted to point out, the materials will be more economical than the cost of steam, in the proportion at least of four to one.

I am happy in being enabled to add, that the subject is now engaging the attention of one of our most distinguished engineer officers, a gentleman whose genius, acquirements, and opportunities give the amplest promise to all his undertakings. I am myself sanguine as to the result ; and though I feel that full success in the attempt is beyond my capacity and resources, I confidently expect to *see*, ere long, the ponderous, expensive, and dangerous machinery of steam, rivalled by the light, economical, and harmless engines which electro-magnetism will place at our command."

Art. VI.—On the family of Rhizophoreæ. By Wm. Griffith, Esq., *Madras Medical Service.*

Account of the Fin of the Balista. By J. W. Knight, Esq.

Meteorological Register kept on board the Experiment Steam Flat, during a voyage from Calcutta to Allahabad. By J. W. Knight, Esq.

From Assistant Surgeon Spry, *Offg. Medical Storekeeper, to* J. Swiney, Esq., *regarding the manufacture of Glauber's salts.—Transactions Medical and Physical Society, Calcutta,* 1836.

The first and second of these papers will be read with great interest by most of our readers. We lament documents of this nature should have been so long withheld from the public. The other articles are also of consequence, one showing the temperature whilst travelling in a steamer during the hottest months of the year; and the other on the manufacture of Glauber's salt.

ON THE FAMILY OF RHIZOPHOREÆ.

"The first peculiarity I shall mention relates to the anthers, and appears to have been first noticed by Jacquin, in his Historia Selectarum Stirpium Americanarum, p. 142, and subsequently by the illustrious Dr. Brown, who adverts to it in his matchless account of Rafflesia, (Linn. Trans. vol. 13, part 1, p. 214) in these words: "In other cases, a separation of determinate portions of the membrane takes place, either the whole length of the theca, as in Hamamelideæ and Berberideæ; or corresponding with its subdivisions, as in several Laurinæ; or lastly, having no obvious relation to internal structure, as in certain species of Rhizophora." I was acquainted with this structure for the first time about three months ago; and was then totally unaware that it was known to Dr. Brown. The first mention I saw of it was in Professor Lindley's Introduction to Botany, in which the above quotation is cited, p. 128. As this structure appears to be confined to the genus Rhizophora, (that is, as I limit it,) it probably has some relation to internal structure. I have met with it in Rhizophora macrorrhiza, and from the examination of young anthers, presume it to exist in Rhizophora Candelaria.

The anthers of these are nearly sessile, of considerable size, and compressed laterally, especially those of R. Candelaria. Their narrowest edges are internal and external; or, in other words, situated anticously and posticously with respect to the axis. On examining their external surface more closely, we perceive numerous roundish opaque bodies crowded together, and apparently imbedded in their substance, and towards their internal edge a depressed line running obliquely upwards and inwards. This line is of small extent in R. Candelaria; in R. macrorrhiza it reaches nearly to the apex of the anther. If we make a transverse section at this stage, which, I should mention, is a short time before the expansion of the flower, we find that the body of the anther is cellular; the cells towards the centre being much the largest and most distinct. Around the periphery a considerable number of small sacs exist. These are entirely closed, more or less ovate, and disposed without any obvious regularity. They are at this period filled with somewhat immature pollen. They are of considerable depth, and perfectly free from mutual communication. In R. Candelaria no sacs appear to be developed along the outer or anticous edge; in R. macrorrhiza, they are developed around the whole periphery. They are however smaller and more compressed along the above edge than elsewhere. The circumferential tissue, or cuticle, as it may be called, is perfectly continuous with the margins of the sacs, and with the tissue interposed between them. In R. macrorrhiza, just before the expansion of the flower, this tissue or cuticle will be found to have separated along the oblique line mentioned above, and from the body of the anther. Two valves are thus formed, which, however, necessarily remain in their original situation. After the expansion of the flower, the inner valve, which is the smaller of the two, separates from its base upwards, and becomes inclined inwards. The outer is curved outwards, and remains attached both by its immediate base and apex.

The body of the anther now presents an alveolar appearance, the alveoli being more or less filled with pollen. Traces of the original continuity of tissue remain adhering to the margins of the alveoli, as well as to those of the depressions visible on the inner surface of the valves, and which previously formed the lids of the alveoli, or rather closed them in. There is no peculiarity of structure in the pollen connected with this singular and anomalous form of anther, which seems to be allied to that of Viscum, so far as may be judged from the representation given in A. L. De Jussieu's Memoir on Caprifoliaceæ and Loranthaceæ, Annales du Museum, tom. 12, pl. 27. fig. E.

The direction of the valves of the anthers may be explained by assuming, that the thecæ, which they may be said to assist in forming, are anterior and posterior, in which case each valve will be single. This assumption, however, appears to me to be contrary to all analogy, nor am I acquainted with an instance of such a disposition. Or, we may take the type of an anther, as Dr. Brown has stated, to consist "of two parallel folliculi or thecæ, fixed by their whole length to the margins of a compressed filament;" the parallelism being transverse. In this view of the case, the valves will be compound; that is, each will be formed of half a valve taken from the right side, and half from the left: the line of union of the two halves being the line of separation in other cases. I do not

know of any such absolutely analogous form of anther; but analogous examples of dehiscence occur frequently in fruits, forming that variety known by the name of *dehiscentia loculicida*. A similar position of the valves might result from a twisting of the filament; but this does not appear to take place in the present instance. The development of the pollen will necessarily present some peculiarities, but the great paucity of materials has prevented me from following it up.

The mature cotyledons in Rhizophora, Kandelia, and Bruguiera decandra are consolidated, and form a mass which, towards the base (where it is articulated with the collet), is cylindrical and hollow, towards the apex fleshy and coriaceous; the upper half of this part being generally somewhat constricted, and surrounded by fungous tissue. This tissue appears to originate in the coats of the ovulum, which at some period become detached and pushed towards the bottom of the pericarpial cavity. In these the plumula is lodged in the hollow of the cylinder. Corresponding with this structure, the ovarium is only $\frac{1}{4}$ or $\frac{1}{2}$ inferior, the upper part of the coriaceous capsule being, as it were, exserted*.

In Bruguiera parviflora (Wight and Arnott), and probably in all the genuine species of this genus, the cotyledons are distinct, fleshy, and plano-convex; they are not articulated with the collet. They are besides enclosed in their original integuments, these being only open at the point of exit of the radicle. In these two, the capsule is almost wholly inferior, and entirely enclosed within the calyx. The plumula in B. parviflora is lodged between the cotyledons, and surrounded with a transparent mucilaginous fluid.

The mature radicles consist of a central and peripherical system, the tissues of which, although continuous, present an obvious line of demarcation. The chief bulk is cellular, the cells abounding in amylaceous matter. The proportion of woody fibre varies extremely; in Rhizophora Candelaria and macrorrhiza, it occurs throughout the central system, and is excessively fine; in Bruguiera decandra the proportion of fibre is exceedingly small, and confined to the circumference of the central system; in Kandelia this tissue is very dense, and exists only towards the apex of the same system, and has no communication with the collet. The proportion of vessels is in the roots of some species exceedingly small, in others they appear to be altogether wanting. I may add, that the central system subsequently becomes the wood; the central cells, at least in Bruguiera parviflora, remaining unoccupied, and forming the medulla.

With respect to the exsertion or lifting up of the axis (soulévement), I may remark, that to all appearance it occurs in the genus Rhizophora, and is carried to its greatest extent, perhaps, in R. macrorrhiza. It is not difficult to conceive this effect, when we take into consideration the number of roots that descend from the branches to the ground. These must, during their growth, meet with considerable resistance at both extremities. The arched form which they invariably assume, after penetration into the earth (the convexity looking upwards), is a necessary consequence of that resistance.

The Linnean Genus Rhizophora appears to contain the types of three genera. The celebrated De Candolle, however, keeps it entire. I may remark, that in an order the genuine constituents of which have, with one exception, definite stamina, their constant indefinity in that instance, may, I should imagine, be relied on as a valid character; Kandelia seems therefore, and on account of the structure of the petals, a good genus: and is adopted by Messrs. Wight and Arnott in their valuable Prodromus Floræ Peninsulæ Indiæ Orientalis. Bruguiera is not quite so satisfactory; since B. decandra, Roxburgh's Rhizophora decandra, the figure of which in his collection of coloured drawings belonging to the Honorable Company's Botanic Garden at Calcutta is excellent, has the flower of Bruguiera and the fruit of Rhizophora.

I shall conclude with a synopsis of the Rhizophoreæ which I have met with on the coasts of the Tenasserim Provinces, between the parallels of 16°. 30' and 12°. north latitude.

RHIZOPHOREÆ, R. BROWN Gen. Remarks in Appendix to Flinders's Voyage, vol. 2. p. 549.

1. Rhizophora Linn. (ex parte). Dec. Prodr. vol. 3, p. 31, (ex parte). Wight and Arnott, Prodr. Floræ Penins. Indiæ Orientalis, vol. 1. p. 310.

I may here remark, that if the peculiar structure of the anthers be confined to this genus, it will prove a valuable addition to the generic character.—It appears to me, that two very distinct species have been confounded under R. Candelaria; these I propose to characterise as follows:

1. Candelaria (Dec.) foliis ovalibus mucronato-cuspidatis, pedunculis petiolo brevioribus sæpius 2 floris, floribus 9—12 andris, fructibus subulato-clavatis nutantibus, Dec. loc. cit. p. 32. Wight and Arnott, loc. cit. p. 310. Pee Candel Rheed. Mal. vol. 6. p. 61, t. 34. Mangium Candelarium, Rumph. Amb. vol. 3. p. 108, t. 71, 72.

Hab. add littora limosa maris et æstuariorum oræ Tenasserim, ubique Floret Aprili. Maio.

Arbuscula coronâ latâ fere hemisphæricâ. Flores albi. Petala angusta, sublævia, per æstivationem stamina non amplectentia. Stamina sæpissime 12, quorum 2 sepalo cuique, 1 petalo cuique opposita. Radicula (exserta) 1-, $1\frac{1}{2}$-pedalis.

2. R. macrorrhiza, *mihi*, foliis ovali-ellipticis mucronato-cuspidatis, cymis nutantibus dichotomis petiolos excedentibus, floribus 8 andris, fructibus subulato-clavatis pendulis.

* Both Jacquin and Gærtner have mistaken the structure of the fruit of Rhizophora. The consolidated cotyledons form the "crus" of Jacquin, and the displaced integuments are the "albumen" of Gærtner, and the "calyptra" of Jacquin. According to this author the seed is limited to the radicle and plumula, while the cotyledons of Gærtner are the outer portions of the plumula.

R. Mangle. Roxb. Fl. Indica, vol. 2. p. 459. Ejusdem icones pictæ in Horto Bot. Calcuttensi asservatæ, vol. 8, t 115, bona.

Hab. secus littora limosa maris circa Mergui, oræ Tenasserim, copiose. Floret Aprili, Maio.

Arbor 25-pedalis, coronâ parvâ. Flores semper octandri, suaviter odorati. Petala alba, conduplicata, marginibus villosis. Stamina 4 sepalis, 4 petalis opposita et his per æstivationem amplexa. Radicula (exserta) maxima, 2½ pedalis, subverrucosa.

This appears to differ from R. Mangle of Linneus, a native of the western hemisphere, in the form of the leaves. The habit of these two species is very distinct, as is likewise the form of their anthers. The fact of the fruit of R. macrorrhiza being pendulous, results of course from the greater length of the peduncle. This in R. Candelaria is so short, that the germinating fruit, which is at first erect, subsequently becomes curved downwards by its own weight.

II. Kandelia. Wight and Arnott.

Rhizophora § Kandelia. Dec.

The character of the ovarium, as given by Wight and Arnott, is at variance with the usual structure of the order, and with my own observations. I have found it to have the ordinary structure.

K. Rheedei. Wight and Arnott, loc. cit. p. 311. Tsjerou Kandel. Rheede. loc. cit. p. 63. t. 35. Rhizophora Kandel (Linn.) Dec. loc. cit. p. 32.

Hab. ad ripas limosas fluminum oræ Tenasserim, præcipue ostia versus. Floret Septembre, Octobre.

III. Bruguiera. Lam.

* Floribus 8-petalis.

1 B. cylindrica (W. and A.) foliis lanceolato-obovatis subacutis, pedunculis 1—3 floris petiolis paullo brevioribus, calycis fructus laciniis patenti-reflexis, fructibus cylindraceis acutiusculis.

B. cylindrica. Wight and Arnott. loc. cit. p. 311. Rhizophora cylindrica, (Linn.) Dec. loc. cit. p. 32. Kanil-Kandel. Rheed. loc. cit. p. 59. t. 33.

Hab. secus littora limosa Insulæ Pulo Gyoon et Madamacan, rarius; florens Novembre.

Arbuscula. Flores viridescentes. Calycis laciniæ lineares. Petala albida, apicibus ciliato-pinnatifidis. Fructus penduli 5—6 unciales.

Rheede's figure corresponds tolerably well with my plant, which is distinct from Roxburgh's Rhizophora parviflora.

2. B. parviflora. (W. and A.) foliis lanceolatis vel lanceolato-ovatis obtusiusculis, pedunculis petiolorum longitudine dichotome 3-floris, calycis fructus laciniis erectis, fructibus obtusis.

B. parviflora. Wight and Arnott. loc. cit. p. 311 (sine charactere). Rhizophora parviflora. Roxb. loc. cit. p. 461. Ejusdem Icones pictæ Suppl. vol. 2. t. 4.

Hab. inter alias Rhizophoreas in Insula parva, anglice Madamacan dicta, Mergui proxima. Floret fructusque profert ab Octobre usque ad Martium.

Arbuscula elegans. Flores viridi lutescentes, sub-odorati. Calycis tubus elongatus, subfusiformis. Petala lutescentia, ciliata. Fructus subcylindrici, 4—5-unciales, penduli, apicibus quasi truncati et medio foveolati.

* * Floribus 10—13-petalis.

B. gymnorrhiza (Lam.) Wight and Arnott. loc. cit. p. 311. Kandel. Rheede. loc. cit. p. 57. t. 51, optima, t. 52. mala. Mangium celsum. Rumph. Amb. 3. p. 102. t. 68. mala. Rhizophora gymnorrhiza, (Linn.) Roxb. loc. cit. p. 460. Ejusdem icones pictæ vol. 8. t. 114.

Hab. ad littora limosa oræ Tenasserim; florens per totum annum.

* * * Species inter Rhizophoram et Bruguieram media.

B. decandra. *mihi*, foliis obovatis obtusissimis, floribus dense capitulatis, calycibus 5-partitis, fructibus clavatis sulcatis.

Rhizophora decandra. Roxb. Flor. Ind. Synopsis. Ms. Ejusdem Icones, vol. 8. t. 116, optima, Dec. loc. cit. p. 33.

Hab. ad littora limosa oræ Tenasserim, ad Martaban et Mergui. Floret per menses calidos.

Frutex sæpius humilis. Flores viridescenti-albidi. Petala alba (demum coriacea et brunnescentia), conduplicata, apicibus inciso-laciniata. Stamina petalorum numero dupla, 2 petalo cuique opposita et per æstivationem eodem amplexa. Antheræ biloculares. Calyx fructus semi-inferus, coriaceus; laciniis patentibus. Fructus erectus vel nutans. Radicula (exserta) 5—6-uncialis.

Species flore Bruguieræ, fructu Rhizophoræ.

IV. Carallia, Roxb.

C. lucida. Roxb. Cor. Pl. vol. 3. t. 211. Ejusdem icones pictæ vol. 9, t. 19. mala. Fl. Indica, vol. 2. p. 481. Wight and Arnott, loc. cit. p. 312.

Hab. in humidis oræ Tenasserim ad Moalmain et Mergui, Floret Decembre.

Arbor humilis, ramulis compressis. Folia ovata vel oblongo-ovata, crenulata, interdum integra, coriacea. Cymi axillares, oppositi, dichotomi, foliis breviores. Flores dense aggregati, viridescenti-albidi, odoris forte ingrati. Petala alba. Stamina petalorum numero dupla, alterna petalis opposita et per æstivationem iisdem amplexa. Antheræ biloculares, longitudinaliter dehiscentes. Ovarium 4-loculare, loculis 2-ovulatis. Stylus filiformis; stigma 4-lobum. Ovula pendula. Tegumenta bina distincta. Foramen superum hilum prope.

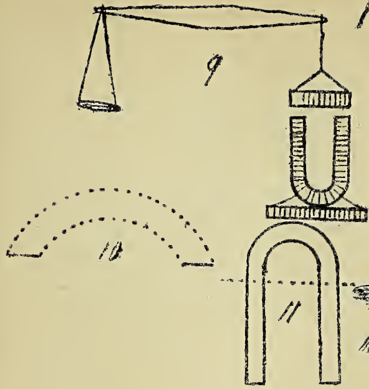
EXPLANATION OF THE FIGURES.

1. Young anther of Rhizophora Candelaria.
2. Ditto ditto of R. macrorrhiza.
3. Transverse section of ditto of R. Candelaria.
3. Anther of R. macrorrhiza about the time of expansion of the flower.
4. Ditto ditto the valves detached.
5. Ditto after expansion, the valves nearly in situ.
6. Pollen of R. macrorrhiza.

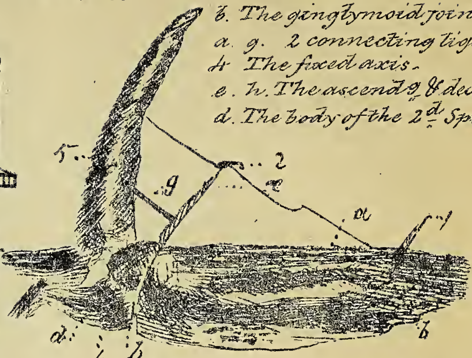
ACCOUNT OF THE FIN OF THE BALISTA.

"The Balistes, belonging to the family of the Sceerodermes, and order Plectognathi, of the subbrachial Malacopterygians, (Cuvier,) possesses in its first dorsal fin, an offensive and defensive weapon, the mechanism of which is curious and highly interest-

Plate 2



5. The 1st Spine.
2. The 2d do.
1. The 3d do
b. The ginglymoid joint.
a. g. 2 connecting ligaments.
4 The fixed axis.
e. h. The ascendg & decendg process
d. The body of the 2d Spine.



Fin of the Balista

Family of Rhizophorea,

ing: a question might be raised, of its being really destined to the purposes I have attributed to it, and more particularly since Cuvier and Lacepéde, who have given descriptions of this fish, have passed it over without notice; but I hope to prove by the position, simplicity and firmness of its parts, that it is equally qualified to fulfil the offices of a fin, and those above mentioned, which I have assigned to it.

The fin consists of three spines, connected by an elastic membrane, extending only to half the length of the first, covering the second and third, and attached to the inner border of the groove on the ridge of the back, in which the rays are contained when at rest. The accompanying sketch will serve to represent a section of the cavity and accessory pieces of the machinery.

The first spine curved and studded in front, with sharp serræ, presents posteriorly a groove, which is narrowed as it descends; from thence a ligament passes backwards to the 2nd spine—at the base are two small tubercles, looking inwards: it forms with capsular ligaments, and the inner margin of the trough, a ginglymoid articulation.

The 2nd spine may be divided into the body, sharpened before its lateral edges, being slightly furrowed, for the reception of the groove of the 1st spine, and smoothed inferiorly, where it plays over a fixed axis. An ascending process, and two descending processes, (one of which only is seen,) articulated with the centre of the circle, of which the axis is a segment.

The 3rd spine is connected to the 2nd by a ligament, and with a nodule of bone on the floor of the cavity forms another hinge joint.

When erection is required, four small muscles, inserted on the sides of the 1st and 2nd spines, raise the fin, which from the mechanism described is fixed so firmly as to resist the strongest attempts at withdrawing it; the latter object is effected by a small muscle on the posterior surface of the 3rd spine, which contracting acts through the ligaments on the whole chain of bones; releasing the body of the 2nd from the groove and tubercles of the 1st, it returns the instrument to its proper sheath.

An engraving of the fish may be found in the 2nd volume of the Plates of the Dictionary of Natural History, by the Professors of the Jardin des Plantes; but singularly enough they have omitted the membrane and ligaments, without which the fin would be rendered imperfect."

METEOROLOGICAL REGISTER, KEPT ON BOARD THE EXPERIMENT STEAM FLAT, DURING A VOYAGE FROM CALCUTTA TO ALLAHABAD, BY J. W. KNIGHT, ESQ.

Dates.	7 A. M.	Noon.	2 P. M.	Sunrise.	Winds, Morning and Evening.	Remarks on the Weather.
April 22nd,				90	S. W.	Violent north-wester at night.
23rd,	76°	84°	83°	76	N. E. by E.—E. by S.	Cloudy morning, smart shower in the afternoon.
24th,	77	84	94	84	N. E. ½ E.—E. by S.	Fine, clear.
25th,	78	88	88	88	S. by E.—N. W. by W.	Ditto, ditto.
26th,	77	85	86	74	N. E. ½ N.—S. W. ½ S.	Smart partial showers about 3 P. M.
27th,	75	78	80	80	E. by S.—S. E. ½ S.	Heavy fall of rain from 6 till noon.
28th,	74	81	85	86	S. W. by S.	Cloudy.
29th,	72	82	84	85	boxing the Compass. E.	Violent storm before day-break; fine day.
30th,	74	85	88	88	S. by W.	Fine, clear.
May 1st,	74	83	87	86	N. E.—S. by W.	Strong breeze; fine day.
2nd,	78	88	88	88	round the Compass. } N. by E.	Fine, clear.
3rd,	74	83	85	86	Variable, N. by E.	Ditto, ditto.
4th,	75	87	89	78	N. E.	Most furious hurricane from the N. W. at ½ past 5 P. M.
5th,	74	84	85	88	N. E.	(Temperature of hot well, Seetacoond, 133°; fine clear.)
6th,	75	88	93	92	E. N. E.—N. N. E.	From 3 to 5, the Thermometer was at 98° and 100°.
7th,	76	88	91	91	N. E.—N. N. E.	Fine, clear.
8th,	78	86	88	87	S. E.	Strong breeze; cirro-stratus.
9th,	76	87	89	85	E. S. E.	Ditto, ditto.
10th,	76	87	87	87	S. E.	Thermometer at 10 P. M. 94°; fine, clear day.
11th,	79	88	90	90	N. E.—N. N. E.	Fine, clear.
12th,	83	83	84	92	S. S. W.—N. N. E.	Fine, clear, strong breeze at night.
13th,	85	93	95	94	N. E.—N. N. E.	Fine, clear weather.
14th,	86° anchored in the Jumna, off the Fort of Allahabad, at ½ past 7 A. M.					

The foregoing register shows the temperature of the atmosphere in the cuddy of the Experiment flat, which is in the after part of the vessel, and has a thin deck; above which was a canvas awning. The temperature on deck was in general from 2 to 3 degrees higher than in the cabins.

There were 34 men and one woman (military detachment) on board, who were accommodated in the centre of the vessel, in a room 28 feet long, by 17 feet broad, and 4½ feet high, across which were 2 large beams which reduced the cubic space for each man o 56 cubic feet. This space receives air and light by 12 hatchways, of which eight were always open; there are no side ports or other means of ventilation, except the hatchways, and one port, which influences ventilation indirectly, i. e. through the non-commissioned officers' room. Mr. Knight considers the space and ventilation insufficient for the number of men who were embarked. It is less than in line of battle ships on the lower deck, when the men are all in their hammocks, as there are then estimated 120 cubic feet for each man; and at sea, one watch being always on deck, but leaving their hammocks below, the space for each man would be double. However the detachment enjoyed good health, there being but few acute diseases, and those were readily cured.

REGARDING THE MANUFACTURE OF GLAUBER'S SALTS.

1. In conformity with the instructions of the board, as contained in their letter to you under date 4th November, 1830, I have the honor to report to you that 800 lbs. of the Glauber Salts have been manufactured at this Depôt, to meet present demands.

2. In connection with this subject, I proceed to lay before you the following details, in the collection of which no efforts have been spared to render them as accurate, and I trust as comprehensive, as the Board might wish. In the analytical part, I consider myself much indebted to Dr. Campbell, of the firm of Bathgate and Co., for the able assistance he has rendered me.

3. The salts are prepared from a mineral earth, known by the name of Khare Muttie; Khare being the Arabic word for Alkali, and Muttie, the Sanscrit word for earth.

4. The only use made of it by the natives of Oude, as far as I can ascertain, is as a condiment; they give it to their sheep, mixed in the food, but to no other animal. It is supposed to have the effect of fining the fleece.

5. The face of the country whence it is brought is flat, and intersected by deep ravines. It abounds in the neighbourhood of Onaoo, a town about 10 miles from the banks of the river Ganges, and is brought to me in hard striated masses, mixed with sand.

6. In rendering the salt free from impurities, little difficulty is experienced. The process adopted by the natives in this part of India is both easy and simple. It consists in boiling the Khare Muttie in little more than its weight of water, the whites of eggs having been previously beaten up and mixed with it, until a pellicle forms. It is then allowed to stand for about half an hour, that the impurities may subside; after which, the supernatant liquor is set aside to crystallize. This process is repeated to free the crystals from any remaining impurities, and the salt is then laid apart for use.

7. Two pounds of earth, treated in this manner, yield one pound of pure Glauber Salts. A specimen of the salt, in its natural and manufactured states, I have the honour to transmit to you.

8. A series of analytical experiments were continued for seven days, and from the results which have been obtained, 200 parts of Onaoo earth were found to consist of,

Dried Sulphate of Soda	145.	90
Dried Muriate of Soda, ...	6.	10
Alumina,....................	25.	0
Oxyde or Carbonate of Iron. ..	1.	5
Siliceous Earth,....	9.	0
Trace of Lime,..............	1.	0
Loss..................	11.	5
	200.	0

9. The regret I should have felt at not being able to state from my personal observation, the capabilities of the different districts in the dominions of Oude, to furnish a supply to meet any demands the Board might be pleased to determine on, has been removed by the circumstance of you yourself, having had satisfactory proof during your recent tour of Hospital Inspection through that country.

10. The expence incurred in the manufacture of 800 lbs. has been as follows:

1000 lb. of Khare earth, with carriage hire,...........	37 8
40 maunds of fire-wood, with coolie hire, eggs, and earthen pans.......	112 8
	150

or 3 annas per pound avoirdupois.

11. In searching for information regarding the existence of sulphate of soda, in a natural state, when first entering into the present inquiry, I was disappointed at finding only a short paragraph devoted to this article, in the Materia Indica, lately published by Mr. Ainslie, of the Madras Medical Service. It is to this effect, " that Dr. F. Hamilton, in his MSS. account of the district of Purneah, alludes to a coarse kind of Glauber Salt being brought from Patna, and called Khare Neemuck :" but, adds Mr. Ainslie in a note: " It is to be presumed, that it is a very impure sort." Dr. Hamilton does not say whether it is prepared at Patna, or found native, which it often is in combination with oxyde of iron, and muriate and carbonate of soda, and sometimes effloresced on the surface of the soil, as in Hungary, and with this he dismisses the subject. I perceive Dr. Ure mentions that large quantities of it exist under the surface of the earth in Persia, Bohemia, and Switzerland.

Dr. Campbell states, that the Khare Muttie exists in large quantities, and it is so rich as to yield by the common process of purification and crystallization full 50 per cent. offine sulphate of soda.

Art. VII.—Bengal Almanac and Companion, and City of Calcutta Register; in two parts. pp. 200. D'Souza and Co., *Church Mission Press. Price Co. Rs.* 2. Calcutta, 1837.

In every department, even that of Directories and Almanacs, there appears to be progression and improvement. The one before us might have been properly called the Stranger's Guide, instead of an Almanac and Register, the least important parts of the work. We have the names and situations of the streets of Calcutta, Government establishments, list of bazars in Calcutta, produce thoughout the year, law department, including those of the Supreme Court, Calcutta Police, and Court of Requests, every department in Commerce, the description of colleges and public schools, literary, scientific, charitable, religious, marine and river insurance societies, places of Divine worship, ecclesiastical, civil, military, and marine lists, uncovenanted assistants in public offices, with a correct account of the streets and numbers in which every person of any consequence is residing in Calcutta. The work is creditable to the industry and zeal of the publishers, and we strongly recommend it to the notice of residents and persons visiting Calcutta.

ORIGINAL COMMUNICATIONS.

ON SOME NEW SPECIES OF THE MORE TYPICAL LANIIDÆ OF NEPAL.

By B. H. Hodgson, Esq.
Resident in Nepal.

For the India Review.

To the account already given of the aberrant Laniadan forms of Nepal I now purpose to add a notice of the more typical ones.

Subfamily Lanianæ.
Genus Lanius (hodie dictus)
Genus Collurio Vigors.
Bhadráya of Nepal (generiecè.)
Species new. Nipalensis nobis.

Form and size. 12½ inches wide by 11½ long, whereof the tail is 5½ and the bill 15-16ths. Tarsus 1, 15-16ths; central toe 12-16ths; hind toe 8-16ths: weight 2 oz.

Make robust, with a large flat head. Bill shorter than the head (an 8th or more), very strong, possessing much and equal breadth and height at base, but extremely compressed forwards, with round ridges and vertical plane sides: culmen half concealed by the frontal plumes, distinctly arched in the whole of the free portion; not keeled; the hook and tooth, large: the lower mandible rising from the gular excavation, with its strongly up-curved point fitting into a deep palatal notch, and its margins very widely and lunately scooped on either side the point. Nares nearer to the tip than gape, elliptic, longitudinal, unfossed, scarcely membraned posteally, and scarcely concealed by incumbent setæ and hairs. Lores and frontal band, rigid: rest of the plumage, soft and discomposed. Rictus to eye and strongly bristled. Wings, hardly exceeding the base of the tail, short, almost rounded, 4th or 5th quill longest, or both equal; the 1st considerably more than half as long as them. Formula of wing 4 inches long, whereof the 1st quill is 2½, the 2nd 3⅝, the 3rd 3⅞, the 4th 4, the 5th 1-16th less; the rest regularly decreasing to the tertials, which are but ⅝ of an inch shorter than the longest prime. Tail nearly as long as the body, consisting of 12, rather narrow, round pointed, frayed feathers, the whole of which are gradated from below; the ten centrals, slightly and equally; the two extremes, abruptly and to the extent of 1½ inches. Tarsi elevate, strong, crossed in front by 6 or 7 distinct and even scales. Toes, medial, compressed, full-soled; the outer and central, basally connected; the inner, scarcely cleft to its root; laterals and hind, equal; central, subelongate; hind, stout and depressed. Claws, strong, moderately curved or acuminated. Tongue, short, flat, cartilaginous; tip, pointed and subbifid or subjagged. Intestines, 10 inches long; two tiny cœca near anal end. Stomach, muscular and red; outer coat, of medial subequal thickness; inner, tough and grooved. Food, all sorts of hard and soft, flying and creeping, insects, and their larvæ and pupæ; also small lizards, feeble birds, mice, and almost any living thing the bird can master. Has its perch on the upper and barer branches of trees and bushes, whence it descends to seize its prey on the ground: sometimes picks it from foliage, but very seldom seizes on the wing. Is common in the open country, in groves and gardens, during winter; but resorts to the woods in summer. Has a harsh voice, very like the kestril's, and is perpetually

vociferating from its perch. Bold and daring in its manners, and easily caught by any insect bait.

Colour. Above, deep slaty; below, with the whole rump and upper tail coverts, bright rusty: chin and throat, centre of the lower belly, lining of wings and quills, internally and basally, rufescent white: wings, externally, black brown, with broad rusty margins including the coverts, and void of speculum.* Caudal plumes, red brown; gradually diluted from the middle into pale sordid rusty, with which the tips of the centrals are sensibly marked. The black frontal band is narrow across the base of the bill, but spreads laterally, and extends through the eyes and ears half way to the shoulders: bill and legs, jetty: base of the former, ruddy flesh colour: iris, dark brown. The female is as large as, or larger than, her mate: her slaty mantle is less deep, and her breast and flanks are crossed by transverse, sublunate zigzags of a blackish hue. She has, also, frequently a white superciliary line over the black band, which latter is usually deficient across the front.

The young are lineated like the female; at first, *above* as well as below, and inclusive of the wings and tail which have both a submarginal dark zone. The black facial band is first grey, then brown in them: the mantle is brown smeared; and all the colours are less pure and more diluted than in maturity, not excepting the bill and legs, which are brown black or dusky.

In early youth the mere chin and mere belly, with the lining of the wings, are immaculate. The changes of the plumage are truly perplexing.†

2nd Species, new. Tricolor nobis. Rather smaller than the last, with characters and habits identically similar. 10 inches by $11\frac{1}{2}$ in expanse of wings, and $1\frac{3}{4}$ oz. in weight. Of the 10 inches of length the bill is 13-16ths, and the tail, $5\frac{1}{4}$. Tarsus 1, 15-16ths; central toe 12-16ths. Hind 8-16ths. A closed wing, 4 inches; whereof the 1st quill is $2\frac{1}{2}$, the 2nd, $3\frac{7}{8}$, the 4th and 5th, subequal and 4; the 5th is usually the longest of all; the tertials being $\frac{5}{8}$ less. The gradation of the tail is $1\frac{3}{4}$ to 2 inches, or more than in the precedent; and the tail is longer in proportion to the bird. This, with the customary prevalence of the 5th alar quill over the 4th (in Nipalensis the 4th is more often the longest), constitutes all the difference of external structure between the two species which the most rigid examination can establish. The sexes entirely resemble each other; nor does nonage afford any very obvious mark.

Colour. Head and neck, superiorly, as far as the gape, with the top of the back, the wings, and tail, jet black. Body, superiorly and laterally, with the vent and tail coverts, brilliant rusty: body below, pure white, in summer subtinted rusty: lining of wings and quills internally and basally, the same: lateral tail feathers paled, basally and marginally, to rufescent white, and the whole broadly tipped with the same hue: tertials next the body with broad rufous margins: a white speculum on the primes, apert and appearing (as usual) from below the false wing: bill and legs, black: iris, dark brown. In the young, the colours are less clear and deep; the black parts diluted with brown; the caudal marks confused; and the bill and legs by no means fully jet; the former having a clear blue grey or fleshy hue towards the base and along the tomiæ.

3rd Species. Ferrugiceps or Rusty-pate nobis. Structure essentially the same as in the two precedent, but assimilating with Collurio minor by its smaller size, longer wing, and shorter and more even tail. 8 inches long by $10\frac{1}{2}$ in expanse: bill 12-16ths; tail $3\frac{1}{8}$. Tarsus 1, 1-16ths; central toe, 10-16ths; hind, 7-16ths: weight 1 oz.

Wings but 2 inches short of the tail, which has the extreme laterals gradated less than one inch, and the rest trivially rounded. Crown of the head and rump, brilliant rusty; the former margined to the front and sides with white: back, tertials, coverts, and caudal plumes, rusty-brown: primaries and false wing, black: no speculum: tertials and coverts with broad rusty margins: lores, lower part of orbitar region and ears, black. Below, wholly white, subrufescent on the flanks: legs and feet, slaty blue: bill, gray blue, with black tips: iris, brown. Female, similar, save that the facial black band is pale brown in her. Almost confined to the lower region of Nepal. Manners of the preceding two species.

LANIANÆ.

Genus Ténthaca nobis.

Téntha and Ténthaca of the Nipalese Taraï.

The birds of this proposed genus differ very signally from the typical Lanii (Collurio of Vigors) by a longer, straighter, slenderer, and more conical bill, distinctly fossed at the base, and less incumbered by the frontal plumes, more suddenly bent at the tip, and less powerfully hooked and toothed; by longer and stronger wings; a shorter and even tail; and much feebler legs and feet, with toes differently constructed and

* The absence of the speculum is a fixed peculiarity of importance in distinguishing the species.

† *Possibly* there may be a second species, bearing the same relation to Nipalensis as excubitoroïdes does to excubitor; but I doubt it.

more exclusively suited to perching. In all respects, there is a strong tendency towards our Edolian Bhúchangas, especially Albirictus, which has a bill almost exactly like that of our Ténthaca. Without museum or library, I can, however, but faintly indicate the probable novelty of this form or its true position ; and I shall therefore proceed to such and so careful an account of the structure and proportions of the two species I possess, as will enable men of science in Europe to decide on the propriety and on the location of the proposed genus.

1st Species and type, new. Pelvica nobis.

Structure and size. Bill from $\frac{1}{3}$ to $\frac{1}{4}$ longer than the head, straight, porrect, conico-compressed with roundish ridges, and sub-convex sides ; at base nearly as high as broad and gradually attenuated forwards : a third of the culmen carinated and hid ; the rest, very gradually inclined to the hook, which is decided and sudden, but much feebler than in the foregone : tooth, notch, and recurve, moderate. Nares somewhat advanced, but nearer to the gape than the tip, oval, subtransverse, placed at the fore end of a distinct, broad, and membraned fosse, shaded posteally and superiorly by a process of the fossal membrane and closely shut by an adpressed setaceous tuft. Rictus somewhat elongated and firm, reaching beyond the middle of the tail, or $1\frac{1}{2}$ inches less its end. The 5th quill usually longest ; the 4th and 6th subequal to it ; the 1st more than half as long as the longest. Tertials, $\frac{5}{8}$ inch less primes. Legs and feet, somewhat feeble : tarsi, low, but longer than any toe : acrotarsia, strongly scaled. Toes rather short, depressed, unequal : fores, basally connected ; the outer, beyond the joint ; the inner, half way to it. Thumb stout, equal in length only to the inner fore. Claws very falcate, small, compressed, acute ; hind, strongest. Tongue, short, pointed, and bifid or jagged. Intestines, 11 to 12 inches long, with two tiny cœca near the end. Stomach muscular, of medial subequal thickness, and toughish only on the inside. Food, chiefly grilli, also mantides, crickets, carpenters, grubs (not worms), and caterpillars. Takes its prey either on the wing or amongst foliage. Is shy, adhering to the forests, and has the unamiable voice of the typical Lanii.

$9\frac{1}{2}$ inches long by $14\frac{1}{2}$ wide and $1\frac{3}{4}$ oz. Bill 1, 3-16ths ; tail, 4; tarsus, 15-16ths ; central toe, 10-16ths; hind, 7-16ths. A closed wing $4\frac{3}{4}$ to $\frac{7}{8}$, whereof the 1st quill is $2\frac{5}{8}$, the 2nd 4, the 3rd $4\frac{1}{2}$, the 4th, one or two, and the 6th two or three, lines less the 5th and longest : the rest, after the 6th, rapidly decreasing till they are taken up by the tertials, which occurs at the 9th quill.

Colour. Half the nareal tuft with the upper surface of the head and neck, soft grey blue : the other half of the nareal tuft with the lores, orbits, ears, and part of the neck, black : body above, with the wings and tail, rusty brown : a band across the croup, and the whole inferior surface, white : alar and caudal plumes, with their larger coverts, zoned all round, just within the pale edge, by a blackish zigzag line : lower part of the black, more or less lineated transversely with the same. Bill, black : legs, dusky slaty : iris, light brown. The female is rather larger than her mate, and has the cap and mantle of an uniform greyish brown. She has no black band on the sides of the head : her bill is fleshy brown ; and her legs slaty or plumbeous.

2nd Species. Leucurus nobis. Size small : characters and habits of the precedent. $6\frac{1}{4}$ inches long, whereof the bill is 15-16ths, and the tail $2\frac{1}{4}$. Above, sordid brownish grey, or stone grey : below, white, with a faint tint of fawn on the breast. Lores, orbits, and ears, black : nareal tufts, grey : longest superior tail coverts, black : the two central caudal plumes, concolorous with the body above, but darker ; the next, blackened, basally and internally, with gradual decrease and supercession by pure white : bill, dusky : legs, slaty : iris, dark brown. The female has a brownish instead of black facial band ; but is otherwise like her mate.

Remarks.—Both the above species are much more common in the lower region of Nepal than in the central or northern. The resemblance of the bill to that of Bhuchanga Albirictus is (as already noted) striking. There is, also, a considerable likeness in this member to the rostrum of Phœnicornis princeps ; but it is longer in proportion, less plumed at base, less spreading laterally, more conical and slenderer, but, at the same time, stronger than in Phœnicornis. The feet, too, of our genus are very similar to those of both the above named species ; with, however, a much nearer approach in this instance to Phœnicornis. The wings have less power and acumination than those of Phœnicornis or of Bhuchanga, particularly the latter. But they have, and more palpably, a greater share of both qualities than the wings of the typical Lanii.

I have no species of the restricted genus Lanius wherewith to compare our Ténthaca. But if (as is asserted) the bill and feet of Lanius be similar to those of Collurio, there can be no question that our genus differs most materially from Lanius in regard to those most influential members ; tho' it approximate thereto, in the structure of the wings and tail.

Valley of Nepal, 1836.

GENERAL SCIENCE.

CATALOGUE OF PLANTS COLLECTED AT BOMBAY.

By John Graham, Esq.

(*Continued from page* 382.)

59. Barleria *pronilis.* { Common on waste
60. ,, *longifolia* { lands.
61. ,, *cristata.* *
62. Bombax *pentandrum.*
63. ,, *heptaphyllum.* The first I have only seen in gardens; the latter is a very common tree. Both are deciduous, and the numerous large glowing red flowers of the latter make a very showy appearance when the tree is totally destitute of leaves. February and March are its flowering months. The cotton, I believe, which it produces, is of no value.
64. Butea *frondosa.* The immense clusters of red coloured pea flowers which this tree produces, have also a very showy appearance—they come before the leaves,—independent of the flowers, the tree has nothing to recommend it in the way of beauty. It is not very common; several grow in Elephanta.
65. Butea *superba.* A very strong climber, with far more splendid flowers. It grows on Salsette—rare.
66. Bryonia *grandis.*
67. ,, *scabra.*
68. Borassus *flabelliformis.* Tall Palmyra tree; common.
69. Borago *Indica.* A very common annual springing up in the rains.
70. Bignonia *Rheedii.* I have only seen one tree. The flowers grow on a scape five or six feet long, and give the tree a curious appearance at a distance.
71. Canna *Indica.*
72. Costus *speciosus.* Found it on a hill near Wuzaum Poona road.
73. Curcuma *montana.* Very common on the top of the Ghauts. A species of arrowroot is made from it.
74. Cissus *vitiginea.*
75. ,, *carnosa.*
76. ,, *4-angularis.*
77. ,, *ripanda.*
78. ,, *crenata.*
79. Convolvulus *speciosus.* Elephant creeper.
80. ,, *batatas.* Extensively cultivated.
81. ,, *turpithum.*
82. ,, *grandiflorus.*
83. ,, *paniculatus.*
84. ,, *pes-casprae* *
85 ,, *tigridis*
86. ,, *muricatus.* There are several other species of Convolvulus common, but I have not been able to identify them.
87. Coffea *Arabica* In gardens only.
88. Capsicum *annuum.* Commonly cultivated in gardens.
89. ,, *frutescens.* Ditto.
90. Cocculus *cordifolius.*
91. Cicer *arietinum.* Extensively cultivated in the Deccan and Guzurat. The grain plant. Horses are fed with it instead of corn.
92. Celosia *margaritacea.* An annual springing up every where in the rains.
92. Carissa *Carandas.* Curwund of the Natives; a very common shrub strongly armed, and producing black berries about the size of a sloe, which are eaten raw, or made into jellies, &c.
93. C. *spinarum.* Berries red. This species I have only seen in gardens.
94. Cerbera *Thevetia.* Only in gardens.
95. Ceropegia *tuberosa.* Very rare, I have only once seen it on Malabar Hill.
96. Crinum *asiaticum.*
97. Cardiospermum *Halicacabum.*
98. Cassytha *filiformis.* Common in jungles.
99. Cassia *Fistula.* Elephanta and Salsette.
100. ,, *Sumatrana.* In gardens only.
101. ,, *auriculata.* Very common in the sterile parts of Deccan.
102. Cochlospermum *Gossypium.* } in gar
103. ,, *serratifolium.* } dens.-
104 Coreopsis *tinctoria.* Grown in pots &c., as an ornamental plant.
105. Crataeva *religiosa.* Commonly to be found in the neighbourhood of temples.
106. Cactus *Ficus indica.*
107. Calyptranthus *caryophyllata.* Native name Jamb; the fruit is eaten.
108. Capparis *Zeylonica.*
109. ,, *trifoliud,* or *Crataeva religiosa.*
110. ,, *sepiaria.*
111. ,, *acuminata.*
112. Calophyllum *Inophyllum.* A very pretty tree, common in the Concan and Malabar. Oil is expressed from the seeds and used for lamps by the poorer classes of natives
113. Corchorus *acutangulus.* Annual common in the rains
114. Clerodendrum *Siphonanthus* In gardens only.
115. ,, *infortunatum* †
116. Clerodendrum *fragrans* in gardens.

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*I have picked specimens of this plant in Danes' Island, Whampoa, China. A very good figure of it is given in Osbeck's voyage to China—a work which those who write on the botany of that country should not fail to consult. —Edit.

* This fine creeper occurs abundantly on the shore by the race course of Macao in China, occupying the place of the C. *Soldanella* of the Scottish coast.—Edit.

† This plant occurs in Danes' I. China.—Edit.

117. Cleome 5-*phylla*.
118. ,, *viscosa*.
119. Crotularia *verrucosa*.
120. Clitorea *Ternalea*.
121. Citrus *Decumana*. Pummalo or shaddock, commonly cultivated.
122. Citrus *Aurantium*
123. ,, *Limetta*.
124. Cacalia *sonchifolia*.*
125. Chrysanthemum *Indicum*.
126. Cadsuarina *muricata*. Common in Bombay, where it is planted for ornament. It shoots up very rapidly.
127. Coix *Lachryma*.
128. Cicca *disticha*. Fruit sometimes used for tarts.
129. Cocos *nucifera*.
130. Caryota *urens*. This beautiful palm grows plentifully on the Ghauts.
131. Croton *variegatum*. This has obtained the name of laurel, and is very commonly grown in pots. The temporary bungalows on the Esplanade are surrounded with it to keep out the glare of the sun. The C. Tiglium grows in Guzurat. I have never seen it.
132. Cynanchum *extensum*. A common twining plant.
133. Cucurbita *Citrullus*.
134. ,, *hispida*.
135. ,, *lagenaria*. The melon and cucumber family are very generally cultivated, and form a common article of food with the natives.
136. Cucumis *sativus*.
137. ,, *Colocynthis*. In the Deccan.
138. ,, *Melo*.
139. ,, *acutangulus*.
140. ,, *Citrullus*.
141. ,, *Maderaspatanus*.
142. Cylista *scariosa*. Scarce.
143. Cannabis *sativa*. An intoxicating liquor called Bhang is prepared from it.
144. Cycas *circinalis*.
145. Carica *Papaya*. Generally cultivated.
146. Cassandra *undulæfolia*.
147. Carthamus *tenebrans*.
148. Caesulia *axillaris*.
149. Combretum *decandrum*.
150. Conyza *cinerea*.
151. Cordia *Myxa*. A tree much resembling the alder. Fruit sometimes pickled.
152. Cordia *angustifolia*.
153. Coronilla *grandiflora*. Natives commonly plant this tree about their houses. It has large showy flowers and is of very quick growth.
154. Ceanothus *Zeylonica*, Elephanta.
155. Celtis *orientalis*.
156. Caesalpinia *pulcherrima*.
157. Capparis *aphylla*. Common in the barren lands of Deccan.
158. Careya *arborea*. I have seen only one tree on Malabar hill.
159. Casearia *elliptica*.
160. Chloris *barbata*.
161. Cyperus *rotundus*.
162. Cynosurus *indicus*
163. Callicarpa *lanata*.
164. Celastrus *montana*.
165. Cynometra *cauliflora*. In gardens, scarce.
166. Cookia *punctata*.
167. Cyperus *dubius*.
168. ,, *compressus*.
169. Commelina *communis*.
170. Cleome *icosandra*.
171. Cissampelos *convolvulacea*.

(To be continued.)

* This plant is also a native of China. I have found it abundantly on a rocky point W. of Danes' Island village, Whampoa, and also on the opposite side of the river Tigris. The correspondence of the Flora of Malabar and China is very striking, but the present catalogue shews that the same observation does not apply to the Concan coast.—Edit.

ON SOME ASTRONOMICAL METHODS OF OBSERVATION.

By William Galbraith, A. M.,
Teacher of Mathematics, Edinburgh.
(Continued from page 384.)

REMARKS ON THE METHODS GENERALLY EMPLOYED IN MAKING CIRCUMMERIDIAN OBSERVATIONS.

When the smaller instruments of astronomy are employed by the method of repetition, it is of importance to observers to be aware of the limits within which their observations ought to be restrained, so as to insure the requisite accuracy. This is the more to be insisted upon, as some authors seem unconscious of the limits to which observations, under given circumstances, ought to be restricted, and unacquainted with the degree of accuracy resulting from the use of different tables in the hands of the public.

The usual tables of reduction are generally formed by throwing the expression derived from the principles of spherical trigonometry into a series of two or three terms. In general, however, when it becomes necessary to embrace more than one, or at most two terms, besides the probability of introducing other errors, the application of a series is more troublesome than the direct computation by spherical trigonometry, and to avoid these, it becomes necessary to select objects which, by their situation with respect to the observer, are convenient and proper for such a mode of observation.

In general, it may be remarked, that objects near the zenith, though the most eligible for zenith sectors, or mural circles, are disadvantageous for smaller instruments, such as Borda's repeating circle, or other portable altitude and azimuth circles, when the observations are repeated a considerable number of times near the meridian. For the use of the latter class of instruments, a considerable zenith distance is necessary to obtain the requisite accuracy, for it will be found, by direct calculation, that, when the latitude is 30°, the declination 20°, of the same name with the latitude, and consequently the meridian zenith distance 10° that even Delambre's formula embracing these terms gives results erroneous to the amount of 47″ in excess, if

the horary distance from the meridian, when the observation is made, extend to 30 minutes of time; though, no doubt this error is diminished when combined with observations made near the meridian. Again, when the latitude is 40°, the declination 20°, and the zenith distance also 20°, the same formula to three turns gives results incorrect to about half a second in excess, while the first two turns, or those commonly used, give an error of about 4″ in defect. Lastly, when the latitude is so high as fifty degrees, the declination still 20°, and the zenith distance 30°. Delambre's formula to these turns gives, at 30 minutes distance from the meridian, correct results; while two turns give a small error of about half a second in defect. Assuming different numbers somewhat analogous but with similar relations, the same conclusion would follow. It may, therefore, be concluded that when the zenith distance in mean latitudes amounts to about 30°, two terms of Delambre's formula, or their results in tables, are sufficiently correct for practical purposes at a horary distance from the meridian of about 30 minutes, and then the calculation for the mean of a considerable number of repetitions is comparatively simple.

Instead of Delambre's formula, or tables derived from it, some practical astronomers recommend a table given by the late Dr. Thomas Young, consisting of natural versed sines, which are nothing more than the first part of Delambre's table in a less convenient form, and requiring the additional trouble of employing a constant log within to convert them into Delambre's numbers in every operation, without any equivalent advantage in any respect over the other method;* in the words of Dr. Pearson, "Dr. Young having simplified (complicated he should have said) the preceding formula by omitting the second term," &c. Now it has already been shown that the second term cannot be admitted unless the zenith distance be considerable, not less than 20°, or 30°, at 30 minutes from the meridian, or the object to be observed be a circumpolar star not very distant from the pole, in mean latitudes, and of this any observer may easily satisfy himself.

If, for example, at London circummeridian observations be made extending to 24 minutes from the meridian, (the extent to which Dr. Young's table has been carried, in a tract published by Messrs. Troughton and Simms,) to determine the obliquity of the ecliptic at the summer solstice, the first two terms of Delambre's formula would be sufficient, though Dr. Young's table, recommended by Dr. Pearson, and more lately approved by Mr. Simms, would, at 24 minutes from the meridian, give results erroneous to about 7″, a quantity quite inadmissible, though this problem is just such a one as is, under the given circumstances, suited to the smaller class of altitude and azimuth circles, generally in the hands of astronomical students, and repeating circles previously alluded to.

* The author of these remarks has endeavoured to remedy this elsewhere.

If, however, the horary distance from the meridian be, under such circumstances, restricted to 12 minutes of time, which will admit of a sufficiently extensive number of repetitions useful to exterminate casual errors of observation, reading and dividing; two terms of Delambre's formula will be fully adequate for the purpose, while the error arising from the use of Dr. Young's table will not exceed half a second.

With regard to the most eligible size of an instrument, it is difficult to come at an accurate conclusion. That must, in a great degree, be regulated by the purposes for which it is intended. I am strongly inclined to think, however, that circles of moderate size, and of the most simple yet substantial construction, are the most likely to give satisfaction. Very large mural circles that do not revolve in azimuth, especially when employed to make observations on the sun, are liable to suffer unequal expansions from heat on that side next the sun, being acted on powerfully if not shaded, which it is difficult to do completely, while the opposite side is slightly affected by its position in the shade of the other, and it is doubtful, in my opinion, whether a considerable number of microscopes except under peculiar circumstances will correct the errors arising from this cause. On the other hand, a much smaller instrument revolving in azimuth, and by that means having its different sides, though as much shaded as possible, exposed partially in succession to the sun will expand much more equally, and when the mean of three or four verniers or microscopes read at each observation, which may be repeated two or three times in pairs of double observations, within the proper time near the meridian; on the principles of the theory of probabilities, the errors arising from all the different causes affecting the accuracy of the results must, in a great degree, destroy each other.

Though this conclusion is the most probable in reference to a steady well constructed instrument, yet it must be received under certain qualifications, since too much praise has doubtless been lavished on the omnipotence of Borda's repeating circle, especially by foreigners. M. Biot, after explaining the principles of the repeating circle, says, "Let us examine, now, in what respect the repeated multiplication of the angle proves advantageous. It would have none, if the divisions cut upon the circle were mathematically exact, and if the observer could direct the intersections of the cross wires in his telescope perfectly correct, for, in that case, one observation would give the zenith distance exact. But as these conditions cannot be accomplished in practice, the repetition of the angles supplies the defect by compensations. With regard to the error of the divisions, it is clear, that the arcs measured, follow without interruption upon the limb, in such a manner that the print of the limb, which is the termination of the previous observation, becomes the origin of the succeeding. From this it follows," says M. Biot, "that the sum of the observations, or the whole arc passed over by the verniers, *comprehends no intermediate error*, but the errors

of the two extreme readings at the commencement and termination of the observations." That this conclusion of M. Biot may be true, it is necessary that there be no, or at least an insensible, resistance in the centre work to the action of the tangent screws, and that there is no imperfection in the tangent screws in producing motion, nor in the clamping screws in securing permanent positions. Now, it is clear that if there is the least defect in all or any of these, M. Biot's conclusion will be erroneous, and such must of necessity be the case to a certain degree, since it depends upon the materials of which the instrument is constructed, and cannot be removed by the abilities of the artist, or the perfection of the workmanship, however excellent it may be. *Hence, it necessarily follows that a slight relative motion must take place between the verniers and the circle for each repetition, causing by that means a small error, which will be continually repeated, and which, therefore, the principle of repetition cannot cure.* It is, I believe, owing to this cause that a constant error of about 5″, according to Baron Zach, may remain in some instruments in a series of many hundred observations made with the repeating circle when the clamping irons are imperfect. M. Biot goes on to say, that the errors of the extreme readings at the commencement and termination are much diminished, because the circle has generally four verniers that are read separately, and of which, the mean marks the commencement and termination of the total with a great probability of accuracy. Finally, the small error which still remains, notwithstanding these precautions in the extreme readings, is distributed over the entire arc measured on the limb, and therefore has an insensible influence on the simple value of one observation, when these observations are sufficiently multiplied. The errors of the division, then, in the repeating circle itself are also thus diminished by repetition, and the compensation of errors is not the effect of probability, but of certainty.

"To estimate the extent of this compensation, it may be remarked, that our (French) repeating circles are generally about 15 inches in diameter, and the error of division cannot exceed 15″. If the error would be reduced to half a second after thirty observations, what would it become after eighty or one hundred? What does it become after, as has often been done, the series of different days are made to succeed one another, without interruption, upon the limb, so that the two errors of the extreme readings are extended upon a total arc, which contains the simple arc many thousand times? The errors of division, then, in this instrument become evanescent, and it is impossible they can be entirely destroyed in the largest instruments, if they are not repeaters. Never can the address of an artist equal a mathematical proceeding."

But there are other errors which are destroyed by the principle of probabilities in the use of the repeating circle, that still remain in other instruments. Such are, the errors of the level, which were small in the original repeating circles, and in those later constructed still less, in which the divisions of the level give immediately fractions of a second. Such is also the case with the errors of *pointing*, or those arising from directing the intersection of the cross wires of the telescopes to the object observed, which, though small of themselves, are destroyed like those of the level by their fortuitous compensation in many thousands of observations. These errors exist also (though I may add in a less degree) in the observations made with large instruments, as the mural circles. For the error of pointing is still found, though diminished by the greater power of the telescope, and that of the level is represented by the error of the plumb-line. But in this case the small number of observations does not admit of a compensation as exact as in the repeating circle. If we suppose that the accuracy of mean results is in the ratio compounded of the number of observations, and of the length of the radius of the instrument, *one hundred observations* made with a repeating circle of two decimetres, or about eight English inches radius, would be equivalent to *one* observation made with a mural circle of twenty metres radius, or about sixty-six English feet. "Could we obtain such instruments," says M. Biot, "and, above all, could we employ them in observations which require us to transport them from place to place?" Now, though the repeating circle is, in the hands of an able observer, an instrument capable of great precision, yet we cannot assent to the extravagant eulogium thus betowed upon it by M. Biot in his Astronomie Physique, because it rests on assumptions too gratuitous to be granted without qualification; and, as we have already remarked, *he has not alluded at all to the errors inseparable from its construction*, and the *method of using it when executed by the best artists.*

However perfect the damping screws may be, yet still, by repeating the observations, repeated small relative motions by pressure must take place between the verniers and limbs, which remain as a constant error that no continuation of the process of repetition can remove, because it arises from that very principle. If, however, an equal number of observations at nearly equal zenith distances on opposite sides of the zenith be taken, then on the principles of probabilities, it may be expected that the errors from this cause will likewise have a tendency to destroy each other. Thus, by a judicious use of the repeating circle, it may be employed to great advantage in all observations which require a moderately sized instrument capable of easy transportation. Still, however, the complex nature of its construction and the involved methods of observation are inherent disadvantages, which render a commodious instrument of similar dimensions but more simple in principle a desideratum to a numerous class of practical astronomers.

The only other instruments, whose prices are moderate, and dimensions convenient, are Captain Kater's circle somewhat enlarged, and Mr. Troughton's portable altitude and

azimuth circle. In these the repeating principle so much recommended in Borda's, is dispensed with for the purpose of securing stability and permanency of adjustment, which are the main desiderata in the other.

Though the same principle of repetition cannot be practised by these instruments as in that of Borda, yet the observations may be repeated near the meridian with success, in which the constant error arising from the imperfection of the repeated damping on Borda's plan, is thereby avoided, while by means of three verniers carefully made, combined with the motion of the celestial body in zenith distance during the time of repetition, the errors of division and pointing will, if not entirely destroyed, be greatly diminished—a proposition supported by uniform experience.

In this country the use of the great mural circle permanently fixed in the meridian is generally adhered to, and by means of its size, the power of its telescope, and the number of its reading microscopes, its errors are supposed to be almost entirely destroyed, though the principle of repetition be abandoned. Thus by the introduction of one advantage, another is lost instead of attempting a union of both. The smaller circles possessing the property of repeating the observations, may, therefore, approach very nearly the precision of the larger, as has been proved in the measurement of the French arc of the meridian compared with the British trigonometrical survey. It is indeed difficult to say, whether the final results of the one or the other possess the superiority, though the former was executed chiefly with Borda's repeating circle of about 16 inches diameter, or 8 inches radius both with regard to astronomical and geodetical observations, while the latter had the benefit of a zenith sector of 8 feet radius, and a theodolite of 3 feet in diameter, both without the principle of repetition adopted by Borda. Hence, it may in general be concluded, that the principle of repetition employed in one class of instruments was nearly equivalent in securing accuracy of results to the advantage of large size, and the superior power of the telescopes in the other. Hence, we may also infer, that one of Mr Troughton's objections to the repeating circle, namely, that when the instrument has a telescope of small power the observations are charged with errors of vision which the repeating principle will *not cure*, is not borne out by experience. Indeed we cannot comprehend the notion why the errors of vision as well as of division according to the usual doctrine of probabilties are, if not destroyed, at least greatly diminished, by the principle of repetition. MM. Lenoir and Fortin have lately improved the movements of the repeating circle in some respects according to Puissant, and Mr. Troughton has given some of its parts a better position for diminishing friction and insuring accuracy of motion, though on the whole it is still complex in its construction, and, so long as its peculiar repeating principle is retained, it cannot be much simplified. The late M. Reichenbach, of Munich, constructed repeating circles, which for some time have enjoyed great reputation, chiefly on account of the goodness of the tangent and damping screws, and the accuracy of the division. The superior telescope is also attached to a circle turning with ease and precision within the graduated circle and having their faces both in the same plane.

On the recommendation of Laplace this artist constructed a large repeating circle of this description for the Royal Observatory at Paris. Whatever properties it may possess yet it has been thought advisable to have also a large mural circle on the principles of Mr. Troughton constructed by Fortin, which the French express a hope will contribute greatly to the advancement of astronomy. From these circumstances it seems to be admitted that the powers of the repeating circle have been overrated, and that the advantages derived from the repeating principle are in a great degree counterbalanced by the defects of its construction. May we, therefore, infer that the smaller class of portable circles of the constructions of Troughton and Kater, which admit of repeating the observations near the meridian a sufficient number of times to insure accuracy, are, from the compactness of their structure, their stability, and accuracy of motion, superior to the repeating circle. Of all these circles Kater's is the cheapest and susceptible of great accuracy when not too small. The size I would venture to recommend would be about 6 or 8 inches in diameter with telescopes magnifying 20 or 30 times and the three verniers each reading 10″. To those who are willing and able to afford the expense, one of Troughton's altitude and azimuth circles of 10 or 12 inches in diameter would prove an excellent instrument, though for travellers it would be rather too heavy. In that case Kater's would be a good substitute, and its efficiency will be shown in the following observations.

(*To be continued.*)

ON THE FORMATION OF SULPHURIC ACID.

By Thomas Thomson, M. D. F. R. S. L. and E. &c.

Regius Professor of Chemistry in the University of Glasgow.

It is well known that sulphuric acid is manufactured in this country by the combustion of sulphur. The sulphurous acid formed is passed into large leaden chambers, where it comes in contact with nitric acid and a small quantity of water; the fumes of the nitric acid being sent into the leaden chamber at the same time with the sulphurous acid. Now, whenever any sloping part occurs in the leaden chamber at some height above the floor which is covered with water, there is a deposit of a white saline matter.

This saline matter is in small scales. It has an excessively acid taste. When exposed to the air it gradually runs into a liquid, which is pure sulphuric acid. When thrown into water a violent effervescence takes place, nitrous gas is given off in abundance, and a solution of sulphuric acid remains. This saline matter has been repeatedly examined. Davy considered it to be a compound of nitric acid and sulphurous acid. Dr. Henry examined it some years ago, and concluded from his experiments that it is a compound of hyponitrous acid and sulphurous acid.

By the kindness of Mr. Tennant I have had repeated opportunities of examining this matter in a state of great purity. I have subjected it to various experiments, and have been led to form a different opinion from that entertained by Dr. Henry of its composition. How far the experiments which I shall detail warrant that opinion, I leave to practical chemists to determine. The analysis is not quite satisfactory, because we cannot determine experimentally the quantity of water present.

1. When a quantity of the saline matter is mixed with water in a retort, a strong effervescence takes place, and nitrous gas escapes in torrents. The whole dissolves in the water, with the exception of a small quantity of white matter, the weight of which varies in different specimens. This white matter when dried is a tasteless powder, insoluble in water. When heated it takes fire, and burns with a blue flame, while some sulphur sublimes. What remains is pure sulphate of lead. These phenomena characterize *lead sulphite of lead.* Hence, it is evident, that the saline matter from the leaden chambers contains *sulphite of lead.* From 550 grains of saline matter I obtained 8·43 grains of sulphite of lead, or about 1.53 per cent. In another experiment 160 grains of the saline matter yielded 1·4 grains of sulphite of lead, or somewhat under one per cent. These two experiments show the two extremes; in all the others the quantity was intermediate.

2. 58 grains of the saline matter were heated in a small retort. The solid matter became partially liquid and fumes of nitrous acid made their appearance. On increasing the heat an effervescence took place, and gas passed rapidly. It was yellow like nitric acid fumes, and like that acid acted on mercury, which prevented me from collecting the gas. When the effervescence stopped, a colourless liquid remained with a small deposit of sulphite of lead at the bottom of the retort. This liquid was colourless, but it effervesced violently giving out nitrous fumes when mixed with water. It remained, therefore, the same mixture or compound as the original saline matter.

3. When the saline matter is triturated with carbonate of ammonia, combination takes place without any sensible decomposition.

4. It was triturated with a quantity of bicarbonate of potash in powder, which from previous experiments was judged capable of just saturating the uncombined acids. Fumes of nitric acids were given off till the whole became quite dry. The trituration being continued, the mixture softened into a white paste, which was left exposed to the air for some hours. On examining this residue, it was found to consist chiefly of a mixture of sulphate of potash and carbonate of potash with a very little nitrate; the nitric acid had been almost all dissipated during the trituration.

5. 160 grains of the dry saline matter were put into a retort mixed with water and the deutoxide of azote collected as it was extricated. The quantity of this gas evolved, supposing the thermometer at 60° and the barometer at 30 inches, was 59 35 cubic inches.

The liquid in the retort being freed from the sulphite of lead, was found to be a solution of sulphuric acid in water, without any trace of nitric or sulphurous acid. This sulphuric acid being obtained partly in the state of sulphate of soda, and partly of sulphate of barytes, amounted to 132.24 grains= 105·79 grains of sulphurous acid.

The weight of the nitrous gas obtained was 19·17 equivalent to 34·5 grains of nitric acid.

The constituents obtained were,

Sulphurous acid	105·79
Nitric acid...........	34·50
Sulphite of lead	1·40
	141·69
Loss..	18·31
	160·

This loss must be water. The constituents then are very nearly

1 atom nitric acid	6·75
5 atoms sulphurous acid.	20·00
3 atoms water	3·375
	30·125

That the acid present is nitric and not hyponitrous I infer from the phenomena of the distillation of the saline matter; and from our knowledge of the fact that nitric acid is actually introduced into the leaden chambers along with sulphurous acid, and there being nothing present to convert it into hyponitrous.

There is no evidence from the analysis that the whole acid of sulphur was in the state of sulphurous acid. I am induced from the proportions found to suspect that 2-8ths of it was in the state of sulphuric acid, and 3-5ths in that of sulphurous acid. On that supposition it is easy to see how the atom of nitric acid, by giving out 3 atoms of oxygen, converts the 3 atoms of sulphurous into sulphuric acid, while the acid thus decomposed makes its escape in the form of deutoxide of azote.

The preceding analysis was repeated with very nearly the same result. If the supposition of the saline matter containing 2-5ths of sulphuric and 3-5ths of sulphurous acid be

admitted, then the constitution of the portion examined must have been

Sulphurous acid....	63·87
Sulphuric acid.........	52·90
Nitric acid....	34·50
Sulphite of lead	1·40
Water....	7·33
	160·00

This approaches pretty closely to

3 atoms sulphurous acid ..	12
2 atoms sulphuric acid	10
1 atom nitric acid	6·75
1 atom water........... ..	1·125
	29·875

Probably the water was in combination with the sulphuric acid.—*Records of Science.*

NOTICE OF SOME RECENT IMPROVEMENTS IN SCIENCE.

ELECTRICITY.

ELECTRICITY BY CONTACT.—According to Karsten, the metals, and, perhaps, all solid bodies, become positive in fluids; and the fluid in which they are plunged becomes negative.

2. A solid, which is half immersed in the fluid, acquires an electric polarity; the submersed portion possesses positive electricity, and that which is not immersed, negative electricity.

3. Solid bodies present a great difference in their electro-motive force, in relation to the same fluid, and this difference is the true cause of the electrical, chemical, and magnetic activity of the circuit.

4. If two solid electromotors, but of different electro-motive force, are immersed in the same fluid without touching, the most feeble electromotor receives the opposite electricity to that of the strongest electromotor, and becomes, of consequence, negatively electric.

5. The half of the weakest electromotor, which rises above the fluid, exhibits the opposite electricity to that of the immersed portion, and becomes, consequently, positively electrical.

6. The electro-motive electricity of a fluid depends on the property of being reduced by two solid electromotors, of different force, to such a state that the two electromotors receive opposite electricities. In general, all fluids which are bad conductors of electricity, possess the property which has been pointed out; but not fluids which are not conductors, nor those which are good conductors. However, the intensity of the electro-motive force of fluids does not depend only on the more or less imperfect conductibility, but on other relations which are not sufficiently known.

7. The electro-motive effects of two metals, which form a circuit in the same fluid, are founded upon the continual excitation and neutralization of the opposite electricities which take place in the fluid. They are produced by the electro-motive action of the strongest and weakest of the electromotors upon the fluid, and are accelerated by the immediate contact of two solid electromotors, when the latter are good conductors.

8. The chemical changes which take place in the fluid are, it is true, in proportion to the neutralization of the two electricities produced by the solid elements of the chain. But these chemical changes, and the neutralization, do not follow as cause and effect.

9 In the system of chains which forms the pile of Volta, the opposite electricities are completely neutralized by the solid elements of each chain; that is to say, by the pairs of plates; and there is no electrical current from one pair to the other. (*L'Institut.* 150.)

ELECTRICITY FROM DEOXIDATION. It is well known, that when the peroxide of manganese is brought in contact with platinum, positive electricity passes into the platinum, and the negative into the finger, or whatever body the peroxide is touched with. De Larive has ascertained that the development of the electricity proceeds from chemical action, as it is very weak with distilled water, but becomes stronger with acids or alkaline solutions; for wood being substituted for the platinum, the same effects are produced when the finger is dipped in an acid or alkaline solution, and applied to it. (*Ibid,* 155.)

PEROXIDE OF LEAD, according to Munck, when brought in contact with other electromotors, as copper, zinc, carbon, and peroxide of manganese, developes negative electricity much more strongly than any other body hitherto examined; and forms an excellent conductor of electricity. Hence, it may be employed with great advantage in the construction of dry piles, and even in common piles, instead of copper. (*Poggendorff's Ann.* (1835-6.)

CAPILLARY ATTRACTION.

1. Dutrochet, some years ago, observed, that when two distinct fluids in a tube are separated from each other by a partition having capillary pores, the liquid soon begins to pass in currents through the dividing medium; but the quantity of liquid in each is not the same, so that one of the fluids acquires a greater volume than the other. The stronger stream Dutrochet terms *endosmose*, and the weaker current *exosmose*. Some have supposed, that the difference in the adhesion of the particles of different liquors was the cause of this phenomenon; and that the *endosmose* always took place from the side of the less glutinous fluid. But when solutions of gum and sugar were tried, the endosmose took place from the gum to the sugar, even when the former was twice as much concentrated as the latter. Many acids, as nitric, muriatic, phosphoric, and acetic, when they are separated from water, by an animal membrane, receive the endosmose from the latter. Concentrated sulphuric acid destroys the membrane; and, when diluted, exhibits no signs of endosmose. When oxalic acid and water are employed, the endosmose proceeds from the acid to the

water, and increases in proportion to the strength of the solution. By itself, however, oxalic acid passes more slowly through animal membrane than water. When a solution of tartaric acid exceeds the specific of 1·05, the endosmose takes place from the water to the acid; if it is lighter than 1·05, the process is reversed. The same happens with citric acid.

Dutrochet terms the passage of the oxalic acid to the water, inverse endosmose. The mineral acids do not exhibit this phenomenon; phosphoric acid, however, exhibits it for an instant, when reduced by the addition of water, to the specific gravity of 1·085. Change of temperature affects the passage of the acid through the membrane, as it does its specific gravity.

This agrees with the experiments of Girard, upon the flowing of pure water, and water containing nitrate of potash, through capillary glass tubes. A solution of one part nitrate of potash in three parts water, at the temperature of 40°, flows more readily through a capillary tube than pure water; while above 40° the reverse happens. Dutrochet has found these observations to hold only with animal membranes; not with vegetable, or thin inorganic porous plates.—(*Pharmaceutisches Central-blatt., Feb.* 1836, 92)

2. Jerichau,* of Copenhagen, has obtained some interesting results on this subject. A forked glass tube, $1\frac{1}{2}$ line in diameter, was closed at one extremity with sealing wax, and then the closed leg was filled with water, the covered portion with mercury, and the open leg partly with an aqueous solution of sugar. The tube was placed in a vertical position.

In the course of a week the mercury in the closed leg rose a line, which might lead to the supposition that the wax had not been so closely applied to the glass as to prevent the existence of any capillary opening between the wax and glass. To determine this point another equally curved tube was taken, fused at one extremity, and filled as before. To ascertain the smallest rise, a small mirror, with a transverse scratch upon it, was placed between the legs of the tube, close to the bent leg; so that the scratch, when it cut the reflexion of the eye over the pupil, appeared as a tangent to the upper surface of the mercury in the tube.

On a small rise of the mercury, the eye must be brought forward, when the scratch appears still to be the tangent of the mercury, and passes immediately through the middle of the reflexion of the eye.

After trial, it was found that a tube fused at one end, and about a line in diameter, answered the desired purpose. This tube was filled with water, and then a globule of mercury, which occupied 0·7 line of the tube, was placed in it; some pulverized sugar was dissolved in the water. The tube was then made fast to the mirror, and placed horizontally, in order that the mercury might not be pressed down by its own weight. The drop slowly progressed towards the closed end of the tube. After the lapse of a month, it had advanced about a line. The water which was expelled, mixed itself with the sugar solution; and this was concentrated by evaporation, without depositing any crystals. A solution of gum, substituted for that of the sugar, gave the same result. In ten days, the drop of mercury advanced 0·2 lines towards the closed end of the tube.

The converse of this experiment was tried with a portion of a straight tube, which was fused at one extremity. A dense solution of sugar was placed between the closed end and a drop of mercury; and before the drop some water was introduced. If the latter evaporated, it was renewed. The drop advanced towards the open end of the tube, while the saccharine solution increased in volume by the absorption of water.

Extending his researches in this way, with different liquids, Jerichau draws six inferences from his experiments.

1. That liquids, separated by porous plates, reciprocally penetrate in part through these plates. This, however, has been previously stated.

2. The proportion of the volume, which passes from both solutions in equal time, depends on the nature of the solutions and partition as well as the temperature. It is not, however, a necessary condition, that a greater volume should pass through the plate from the one solution than from the other; or, that on one side of these plates a greater volume should enter, as Dutrochet erroneously thinks.

3. When the diffusion is terminated, the volume remaining on each side of the partition may be calculated from the original volume, being inversely, as the square root of its density; as Graham has shewn with regard to gases. If equal volumes of a saturated solution of common salt, and solution of sugar of the specific gravity 1·078, are separated by a bladder, the first increases in volume at first but diminishes in specific gravity, in a greater degree than would take place by a regular mixture.

4. The height to which solutions ascend in capillary tubes, is often proportionate to the quantity of liquid diffused. Thus, some solutions, which rise highest in capillary tubes, are conveyed in strongest streams, but there are many exceptions to this rule.

5. Liquids are not only conveyed through solid porous plates, but also through a short canal between mercury and glass.

6. By the chemical action of electricity, the proportion of the liquid which passes may be increased; but this cause only operates, in so far as it separates acids, alkalies, and salts.

OPTICS.

EFFECT OF LIGHT IN MAGNETIZING NEEDLES.—Mr. Draper* has repeated the experiment of Mrs. Somerville, which consist-

* Poggendorff's Annalen, xxxiv. 613.

* Journal of the Franklin Institute, February, 1835.

ed in rendering a needle magnetic by placing it under a piece of glass, or blue ribbon, having half its length protected by paper. He did not succeed. He made a very delicate experiment, by admitting "a divergent beam of light through a hole in the shutter of a dark room; the cone of luminous matter, at its apex, was about 1-10th of an inch of diameter, and a hair, or other filament held in it, exhibited the phenomena of diffraction; the colours being received into the eye by a lens. Across this beam a silver wire was adjusted, and each of its extremities connected with cups of mercury, which communicated with the poles of a voltaic battery. It was expected that, if there was any action between a magnetic filament and light, some derangement would be seen in the diffracted fringes, when the current passed; but none such was observable." He found also, that solar light concentrated upon a delicate needle, produced no effect, either in the air or in vacuum. "A needle made of watch spring, about 4 inches long, which in an exhausted receiver, suspended by a filament of silk, exhibited no polarity, had one half of it exposed to the violet ray, cast by an equiangular prism of flint glass. This ray was separated from the others, by passing it through a slit in a metallic screen, and half the needle shielded by a piece of paper. After two hours exposure, it was suspended again in the exhausted receiver, but still showed no token of polarity; it was then exposed to the other rays successively, with the same result."

Mr. Boyle found, that a piece of amber would become electrified by exposure to a sunbeam. Mr. Draper produced the same effect on ruby from Ceylon, rolled sapphire, a tourmaline, a Brazilian emerald, a topaz, and likewise glass. He attributes this to the agency of the light, and not to the heat; because, when exposed to the action of heat from another source, in the same degree, no such consequence followed.

ELECTRICITY AND MAGNETISM.

METHOD OF DETERMINING THE ELECTRICAL CONDUCTIBILITY OF SMALL MASSES.—The usual method of determining this property in bodies, consists in interposing between an electrical source and a metallic wire attached to a sensible electroscope, the body whose conductibility is to be ascertained. For this purpose, an electrical machine, a voltaic or a dry pile is employed. Several ingenious apparata have also been substituted. Lassaigne recommends a modification which he has found to answer. To one of the wires of Schweigger's multiplier, he attaches a small platinum spoon containing dilute nitric acid; above this spoon, is fixed upon a support, a small glass tube, 2·3 inches long, and ·19 inch in diameter. A wire of red copper curved at one of its extremities, traverses it for two-thirds of its length. To this distance the wire is flattened into a spatula, or terminated by a disk. To this part of the wire the body to be tried is attached. It is then touched on the other side with the end of the other wire of the multiplier, and then the curved portion of the copper wire is plunged into the nitric acid. If the body placed between the two wires is a conductor of electricity, the magnetic needle instantly deviates. He has also found, that a thermo-electric cylinder is very convenient; it is formed, by soldering, end to end, two small cylinders, the one of Bismuth, and the other of Antimony. When placed in a glass tube and slightly heated at the point of union, it was placed in contact on one side, with one of the wires of a multiplier, and on the other, with the substance to be tried, and touched at its opposite extremity, with the other wire of the multiplier. The results were similar to those obtained by the first method; *Arsenic* and *Tellurium* were found to be conductors.*

CHEMICAL ACTION OF ELECTRICAL CURRENTS.—The experiments of M. Botto lead to the conclusion, that the direction of a magneto-electric current has an influence, like that of a hydro-electric current, upon the facility which it may have in passing through the same system of conductors. Mr. Faraday has proved, that the different substances which form a circle, experience, in similar circumstances, an equal magneto-electric induction, and, consequently, a tendency to produce the same current. Botto has confirmed this fact. He disposed a magneto-electric helix, having two distinct and equal ends, in such a manner, that when it was traversed in a contrary direction by two currents developed by influence, these two currents neutralized themselves. If in the circle, which these currents are obliged to traverse, we place a vessel filled with acidulated water, and communicating with the conductors on one side by a wire, on the other side by a plate of the same metal, the currents are neutralized. But, if one of them is made stronger than the other, by a change in the number of the spirals in the magneto-electric helix, the effect upon the galvanometer which results from this difference of intensity, is much more decided, when the most powerful current passes into the liquid from the wire to the place, than in the contrary direction. Hence, it would appear, that we are to attribute the double phenomenon which the same heterogeneous circle presents, under the relations of electric conductibility, to the difference of chemical re-action which accompanies the passage of the currents.†

ATMOSPHERICAL ELECTRICITY.—M. Matteuci has lately made some interesting experiments upon this subject. They were conducted, in what is termed in Italy, an English wood (that is, one of small extent) consisting of *Robinia pseudacacia*, *Platinus Occidentalis*, *Gleditzia triacanthos*, *Melia*, *&c.* The electroscope with which the experiments were made consisted of a stem of wood, at

* Journ. de Chim. Medic. i. 630.
† Bibliotheque Universelle, February, 1835.

the extremity of which was placed a common lamp ; a copper wire conducted the electricity from the flame to an electroscope. On rainy or windy days, a very thin portion of phosphorus was substituted for the lamp, and was kept in a tube of glass terminating in a point. He found, that whenever the electricity of the atmosphere is positive (which is always the case in calm weather), it is impossible to have any traces of electricity in the interior of a wood. The most curious mode of observing it, is to move, carrying the electroscope in the hand, either out of the wood, or above the leaves. The flame is scarcely removed 10 paces from the trees, when traces of electricity begin to appear. These increase with the distance. In returning, the first tree is scarcely reached, when the electroscope ceases immediately to indicate the presence of electricity. These general results can only be explained by one of two hypotheses ; either, that the electricity of the air is discharged by the leaves and the vapour of water, and escapes by this means into the earth, or, that there is developed by the effect of vegetable life,—by the respiration of plants, enough of negative to neutralize the positive electricity of the surrounding air. The second hypothesis appears most plausible, because it is difficult to admit the second, when we attend to the conducting power of the flame, and of the column of hot air which is much superior to that of the leaves.

The results of a great number of observations showed that in the night, signs of electricity are often absent, both in the air, and in the interior of a wood. At the approach of day, before the sun appears above the horizon, decided indications of negative electricity appear among the trees, while none are detected in the open air. We can readily understand this observation, if we admit that oxygen is disengaged from the leaves before the rays of the sun strike them directly. In this case, negative electricity appears. If the sky is calm, the signs of negative electricity disappear in the interior of the wood, at the same time that positive electricity is developed in the air. On three days, when the sky was cloudy, and almost stormy, negative electricity was detected in the external air, and in the wood. Hence, it may be inferred, that negative electricity is disengaged by vegetation during the dry, which is constantly neutralized by positive electricity. Matteuci has promised to continue his observations, and expresses a strong desire that similar investigations should be undertaken by meteorologists in other parts of the world, especially in reference to rain.*

NEW METHOD OF MAGNETIZING.—M. Aime recommends the following method, which consists in tempering and magnetizing a bar of iron at the same time. To effect this, a bar of soft iron curved in the form of a horse-shoe, is surrounded with a brass wire, covered with silk ; the two extremities of this wire are made to communicate with the poles of the voltaic pile ; a bar of steel equal in length to the distance between the two extremities of the horse-shoe is then ignited, and seized between a pair of pincers; the two poles of the horse-shoe are then applied to the bar, and plunged into a bucket of water ; in the course of a minute or two after immersion, the bar is detached from the horse-shoe, and a similar operation performed with similar bars extracted from the fire. In order to prevent the brass wire from softening, care must be taken in dipping the apparatus in water to envelope the two extremities of the helix in a rag covered with mastic. The ends of the conducting wire were soldered to the zinc and copper poles of the battery ; a single wire was employed. Aime, however, considers that it may be preferable to unite several into a bundle, or even to take a ribbon of copper covered with silk or varnish. The bar ought not to be detached too quickly from the horse-shoe ; it is necessary to wait until the interior of the steel has acquired a slight elevation of temperature, in order that the molecules may have time to arrange themselves, conveniently, for magnetizing and tempering. The duration of the immersion varies with the size of the bar, and the temperature which it possesses when taken from the fire.*

9 MAGNETISM BY COMMON ELECTRICITY.†—M. Llambias has addressed a manuscript upon this subject to the French academy. The results of his experiments were, 1. In every metallic conductor traversed by the discharge of a Leyden phial, two *magneto-electric* currents are simultaneously discharged, which pass in opposite directions, one of which may be said to proceed from the vitreous to the resinous pole, and the other from the resinous to the vitreous pole. 2. The currents can be partly separated from each other. This separation may be effected in dividing a discharge between two or several different branches of the same circle, when in some particular branch there is an interruption which gives origin to the spark. 3. This separation of currents is more or less practicable, and is comprised within certain limits, which can be nearly determined by experiments for each discharge, and for each of the other elements which produce the phenomenon. 4. The separation of these currents may take place in any portion of the circle submitted to the discharge, at the same time that the other parts of the same circle are traversed by currents completely re-united. 5. In every circle, or every portion of the circle, which the two currents traverse in union, it is, in general, the current which passes from the vitreous to the resinous pole, or the primitive current which has the chief effect in communicating the magnetic influence. 6. Each of the currents magnetizes so much the

* Bibliotheque Universelle, May, 1835, 33.

* Journal de Chime. Medic. i. 370.
† Ibid, i 36.

more strongly in proportion, as it is separated or disengaged from the other; and in general, we may say, that the magnetic power, produced by a discharge of the Leyden jar, is only the effect determined by the simultaneous union of two magnetizing, more or less unequal and opposed, forces. 7. The common simple spark of the machine produces analogous phenomena.—*Ibid.*

NOTICE RESPECTING DR. EHRENBERG'S COLLECTIONS OF DRIED INFUSORIA, AND OTHER MICROSCOPIC OBJECTS.

To Richard Taylor, Esq., &c. &c.

British Museum, 21st June, 1836.

Dear Sir,

DR. EHRENBERG of Berlin, well known for his elaborate work on the *Infusoria**, has recently presented to the British Museum a series of dried microscopic objects, consisting chiefly of infusory animalcules, globules of blood, &c., accompanied by a short notice (too short indeed) of his method of preparing them, and a list of the subjects. Dr. Ehrenberg preserves these most minute and perishable of known organic forms by means of rapid desiccation on little plates of mica, in which manner he informs us that he has succeeded in making a very satisfactory dried collection, not only of nearly 300 species of *Infusoria*, but also of other kinds of microscopic objects. He mounts them betwen double plates of mica, fixed in the cells of slides, in the usual manner of preparing the scales of butterflies and *Podurœ*, and other transparent microscopic objects; and thus, he says, "I have not only preserved the form and colour of the *shielded (cuirassés) Rotatoriæ* and *Bacillariæ*, but also the *softest* and *most delicate* of the polygastric *Infusoria*, even these of the genus *Monas*; as well as the tissue of plants; the *Spermatozoa* and *Cercariæ*; the different sorts of globules of blood, with their nuclei; globules of lymph, chyle, and milk; and the nervous tubes, &c., of a great number of animals, and of man."

A power of about 300 (linear) is sufficient for viewing these objects, "but a lower power does not show them satisfactorily, however well they may be illuminated."

I subjoin a list of the subjects presented to the Museum, and remain,

Dear Sir, faithfully yours,
John Geo. Children.

Slide. No. 1.

1. Monas viridis.
2. Polysoma uvella, and Monas termo.
3. Spirillum undula, and Vibrio bacillus.
4. Euglenia acus; Eu. viridis; Eu. pyrum.
5. Coleps hirsutus.
6. Volvox globator.

No. 2.

1. Paramecium caudatum.
2. Glaucoma scintillans.
3. Trichoda carnium.
4. Charchesium polypinum.
5. Epistylis nutans.
6. Euplotes Charon.

No. 3.

1. Stentor niger.
2. Paramecium aurelia.
3. Glaucoma scintillans.
4. Stentor polymorphus.
5. Stentor cœruleus.
6. Idem—compressed, to show the testiculi.

No. 4.

1. Nassula ornata.
2. Nassula elegans.
3. Nassula aurea.
4. Idem—crushed, to show the teeth.
5. Chilodon uncinatus.
6. Chlamydomonas pulvisculus.

No. 5.

1. Hydatina senta.
2. Idem—crushed, to show the teeth.
3. Polyarthra trigla.
4. Brachionus pala—with its eggs.
5. Brachionus rubens—ditto.
6. Anuræa aculeata.

No. 6.

1. Globules of blood of the Sheep (Ovis aries).
2. Ditto of the Frog (Rana temporaria).
3. Grains of the Retina of the Eye of the same.
4. Spermatozoa vespertilionis murini.
5. Arhnanthes longipes.
6. Meridion vernale; Fragilaria rhabdosoma; Navicula acus; Na. amphisbæna.

Philosophical Magazine, August, 1836.

EHRENBERG'S NEW DISCOVERY IN PALÆONTOLOGY:

TRIPOLI COMPOSED WHOLLY OF INFUSORIAL EXUVIÆ

At the sitting of the Royal Academy of of Sciences of Paris, July 11th, the following letter was communicated, dated Berlin the 3rd of July, from M. Alexander Brongniart:—"I have today become acquainted with a discovery entirely new, for which we are indebted to M. Ehrenberg, and which he has demonstrated to me in the clearest manner; it is that the rocks of homogeneous appearance which are not very hard, friable, even fissile, entirely formed of silex, and which are known by the names of tripoli, more or less solid (*Polierschiefer* of Werner), are entirely composed of the exuviæ or rather of the perfectly ascertained skeletons of infusorial animals of the family of the *Bacillariæ* and of the genera *Cocconema*, *Gomphonema*, *Synedra*, *Gaillonella*, &c. These remains having perfectly preserved the forms of the siliceous carcases of these infusoria, may be seen with the greatest clearnsss through the microscope, and may easily be compared with living species, observed and accurately drawn by M. Ehrenberg.

In many cases there are no appreciable distinctions.

The species are distinguished by the form, and still more surely by the number of *septa* or transverse lines which divide their small body; and M. Ehrenberg, who has been able to count them by the microscope, has observed the same number of these divisions in living and in fossil species.

They are the tripolis of Bilin in Bohemia, of Santa-Fiora in Tuscany, and of other places which I do not remember with certainty, (of the Isle of France and of Francisbad near Eger, if I am not mistaken,) which have given occasion to these curious observations. The slimy iron ore of marshes is almost wholly composed of *Gaillonella ferruginea*.

The greater part of these species are lacustrine, but there are also some marine, particularly in the tripoli of the Isle of France.—*L'Institut*, No. 166.—*Ibid.*

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The next Meeting will be held at Bristol during the week commencing on Monday, August, 22nd; the Members of the General Committee will assemble on the preceding Saturday.—*Ibid.*

THE INDIA REVIEW.

Calcutta: January 15, 1837.

LORD AUCKLAND'S SCIENTIFIC PARTY.

Tuesday Evening, 3rd January, 1837.

We rejoice to see our prediction, regarding the ulterior good to be derived from the instructive and interesting entertainments at the Government House, realized.

The ingenuity of talented men has been in active exercise, and discoveries have been displayed, which will tend to the most important results. Although we cannot concede to Dr. O'Shaughnessy the merit of having discovered the working machine for producing moving power by the application of electro-magnetic influence, yet we must acknowledge that his contrivance of another machine, the model of which was exhibited at the Government House, and is described in our present number, does him great credit for ingenuity, perseverance, and zeal, and will add to that professional renown for promising talents which he has so justly attained. In addition to the foregoing on the present occasion, Dr. Ranken, officiating secretary to the Medical Board,—a gentleman already distinguished for his mechanical genius by his invention of the thermantidote, an engine by which ordinary houses in India can be both cooled and ventilated, brought forward a plan for discovering shoals or obstructions in the way of steam vessels. Dr. Ranken forwarded to us a model, from which we had a drawing taken (plate 3, fig. 8,). The following is the account for which we are indebted to the author.

" The apparatus is attached to the fore part of the vessel, and is intended to act as she proceeds in her course.

" This imperfect model is supposed to represent a steamer afloat, and the trough, in which it slides, the channel of the stream. A shaft or pole (1), equal to the length of the vessel, is projected forward from the bow, where it floats on a level with the waterline. At the further extremity of this shaft is a cylindrical cross-bar, (2), the length of which being optional, is here somewhat greater than the breadth of the steamer. The crossbar, perforating a row of feelers, (4,5,6,7,8,9,) supports them in a vertical position, where the channel is clear, but allows them to rotate freely and to fall down, when pressed by any thing under water. A lever extending horizontally backward, with holes in it for receiving a weight at different distanees from the top of each feeler, counterpoises the pressure of the water and the force of the current on the immersed portion of the feeler.

" These feelers, the essential part of the contrivance, descend under water as far as the keel, and rise above so as to be fairly in view from the deck of the steamer. If the lower ends of any of the feelers, thus immersed, come upon a shoal, sand bank, or sunken tree, they are forced backward and upward, when of course the opposite ends or tops, visible above water, sink forward and downward. The exact situation of any obstruction or danger to the vessel may in this manner be indicated in time, it is believed, to enable the helmsman to avoid it,

by steering where other feelers, still remaining vertical, shew the channel to be clear.

"The small paper tubes on the tops of the feelers shew where *lanterns* might be placed, throwing out sufficient light ahead, and rendering every motion of the feelers conspicuous, if the river were navigated at night as well as by day.

"If it were necessary, a man or two could be stationed before the cross-bar where the figure of a boat (3) appears in the model, to see that the machinery keeps in order."

Several of the scientific and nautical gentlemen who examined the model at the Government House suggested partial objections to the use of the apparatus. Its great length, one observed, would probably impede the vessel in turning to either side. Another remarked that, though the long shaft could now be taken off and put on again at pleasure, it was not sufficiently under command while attached to the bow at the water line. To obviate these inconveniences, the same gentleman proposed to let the apparatus down to the water from the foremast, or from a sort of crane by which it might be placed in its proper position or lifted up as circumstances should require. A third, whose knowledge of steam navigation gave particular weight to his opinion, thought the contrivance unobjectionable in ascending the river at the aate of 3 or 4 knots an hour, but not calculated to be of any use in coming down, at double that speed or more, when the warning given by the feelers would not be sufficient to enable the steersman to avoid the shoals in his way.

To these and other remarks the inventor replied to the following effect, in the course of the conversation which took place.

With the exception of the metallic rods, each a quarter of an inch in diameter, which are to form the immersed portion of the feelers, the whole of the machinery is intended to be so light as to float on the surface like a blown bladder. Having the least possible hold on the water therefore, it will scarcely be any impediment to the movements of the steamer.

Were the long shaft of the apparatus extended from a mast or crane elevated above the deck, the height would, in addition to the present length of it, cause the feelers to describe the arc of a larger circle, rising higher and sinking deeper than the keel in the pitching motion of the vessel. It might be an improvement to attach the shaft by a long fork to the middle of the vessel on each side, at the water line, where there is least motion.

It is not generally believed that the velocity of a body through fluid renders it more difficult to turn aside, or a ship less obedient to the helm. It is not meant that the paddles should be backed or the steamer stopped, when the feelers indicate a shoal in her way. When they shew the exact spot where the danger lies, and at the same time let us know where there is enough of water, turning the rudder a few points to larboard or starboard, will apparently make the steamer take a safe course the more readily the faster she is going.

No objection seemed to be urged against the principle of the contrivance, the doubts expressed having reference chiefly to the manner of employing it. Dr. Ranken expected to find that so simple and obvious a means of sounding the bed of a river had already been tried and rejected by practical men for reasons which he could not discover. But this appeared not to be the case, and adverting to the great importance of being able to navigate the rivers of this country with safety in the night as well as the day time, he offered to place a complete apparatus at the disposal of any competent person who had inclination and opportunity to give the contrivance a fair trial.

Mr. Prinsep and Dr. Weifer exhibited the powers of the ox-hydrogen microscope, by which sections of wood, the structure of plants, forms and dispositions of cellular and vascular tissues, and fibres of plants, as well as organic fabrics, cotton, &c. were accurately developed. Entomological descriptions

Fig. 6.

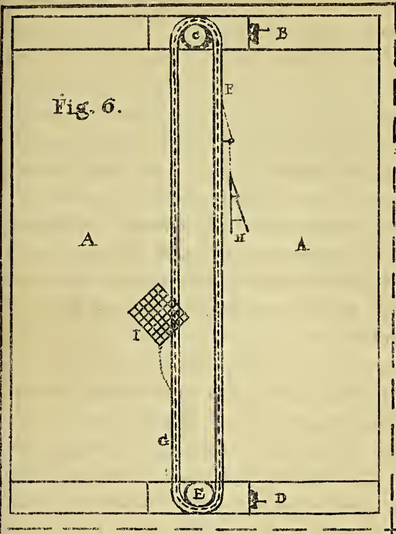


Fig. 5.

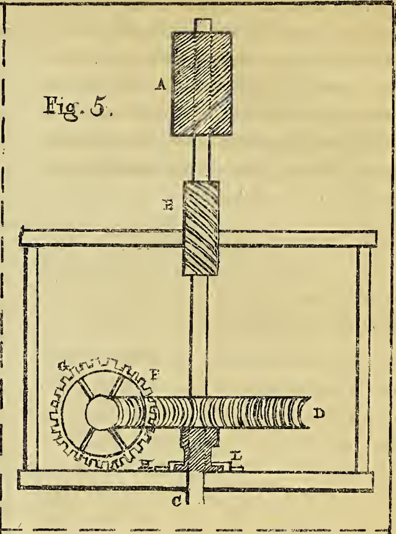


Fig. 7.

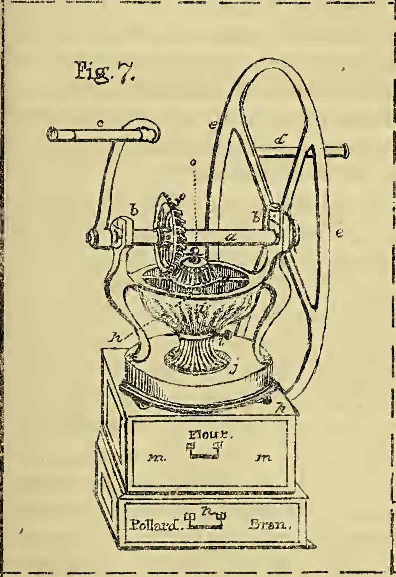


Fig. 1.

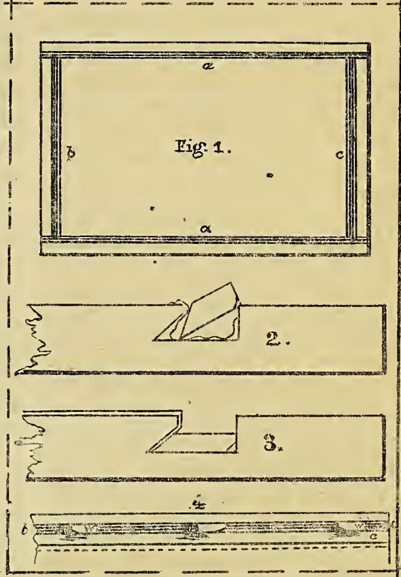
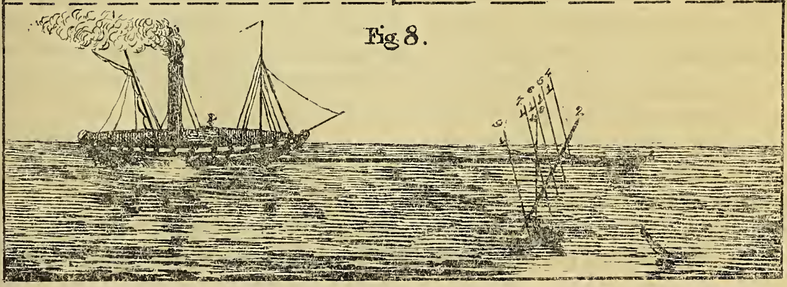


Fig. 8.



were given ; and living infusoriæ were seen contending with and destroying each other, which excited considerable amusement. The animalcules were the most lively animated objects displayed in myriads in our common drinking water : a little brandy was introduced, and they all fell to the bottom,showing the effect of ardent spirits in suspending animation. Among the numerous exhibitions of natural curiosities, we noticed some ærolites which have fallen in India ; the one at Moradabad in 1806, one at Allahabad in 1822, one at Ghazeepore in 1827, and another at Hydrabad in 1831. There were some beautiful specimens of Japhogas Succatus and Pteropus Marginatus of Bengal,and fossil hippopotamus and fossil crocodile from the Sub Himalya, furnished by Col Colvin. Salt from the Samber lake in various states of manufacture,from Lt. Conolly. The skeleton of an ouran outang and one of an albatross. Among the works of art we observed three casts ; viz. those of King William,—Cobbett, and O'Connel in character. Our gracious king was considered an admirable likeness. O'Connel, in the attitude of animated debate, with one hand grasping his waistcoat, laid bare his brawny bosom, with the other arm extended and clenched fist denouncing vengeance on the enemies of his injured country. Cobbett hoary-headed, reclining in despair on a garden bench, was a fine picture of intelligence and age. A silver cup given by Dwarkanath was an admirable specimen of workmanship by Hamilton & Co. The Auckland cup was still more creditable to the abilities of Pittar. The latter had no blemishes as regarded chasteness and design,which unfortunately was not altogether the case with regard to the former. There was also a splendid collection of bronze medals,struck in France under the the orders of Napoleon, in commemoration of his victories, and a very perfect Sciograthicon.

DR. O'SHAUGHNESSY'S & MARSH'S EXPERIMENTS.

We perceive that the editors of the Quarterly Journal of the Medical and Physical Society have given "an account of a new method of separating small quantities of arsenic from substances, with which it may have been mixed, by J. Marsh, Esq." When we commented upon Dr. O'Shaughnessy's description of this mode of separating arsenic from other substances, we had not seen Marsh's clever paper, and therefore Dr. O'Shaughnessy's statement (for we conceive the editorial to be his), that our review was of that document, is incorrect. Our description of numerous tests and advice to judge and juries in quoting the difference of opinion among chemical physicians, the professor denounces as odd mistakes and a proof of our not being, as he is, familiar with the subject: he appeals to men of science in Europe to support his assumption. Now we must protest against any such appeal, if he had a reason on the spot to prove our conclusions erroneous : to have given it would have been but complying with the claims of legitimate discussion. Has the professor so soon forgotten the opinion we gave on his experiments on the blood? When we then pointed out his errors,his reply was the same as it is now ; viz. that he did not consider himself called upon to enter into a chemical discussion with us, as our review had denoted a total want of practical knowledge of the subject. Instead, therefore, of entering into a controversy with us regarding the existence of a supposed new substance in the blood, he would appeal to home authorities. The appeal in this case was in our favor, as shown in our number for January 1836, wherein the experiments by Brett and Bird, of Guy's hospital, are described, the result of which led to conclusions the same as our own. We have since received a long communication from those gentlemen on the same subject, which we have not published, nor should we have adverted to it now, had not the remarks of our friend O'Shaughnessy elicited this defence, and compelled us to point out to our professional brother our desire for free and open discussion of important questions. It is by collision of opinions that truth is elicited ; but the sub-

ject, and not persons, must be addressed. When the latter is the case, bitter and angry feelings are engendered in bosoms where nothing but amity, esteem, and true friendship should pervade, which ought invariably to be the case with all lovers and promoters of science. Therefore, whenever we perceive an error on subjects connected with the public weal and with science, we feel it to be our bounden duty to expose it, without having the least respect to persons, or to any other views than those of discharging the duty of an upright and independent journalist.

PROGRESS OF SCIENCE,

AS APPLICABLE TO THE ARTS AND MANUFACTURES; TO COMMERCE AND TO AGRICULTURE.

IMPROVEMENTS UPON THE HYDRO-OXYGEN MICROSCOPE.

Sir,—In throwing the flame upon the lime in the hydro-oxygen microscope, it is found that deep cavities are formed in it by the violence of the flame, and that it is requisite to move it to cause the fire to act upon another part, otherwise the light becomes dull and the large lenses endangered. This at present (or was till last year, when I directed the maker to cause it to revolve and rise,) is moved by hand, which is inconvenient in several respects; first, if a hole is made, the radiant point of the lens is altered, and perfect distinctness is gone: the object glasses are endangered, and in opening the door to adjust the lime, a light is thrown into the room. Moreover, one of the cylinders of lime will only last one exhibition, whereas, by being turned regularly, it would do for several. The improvement consists in causing the lime to revolve regularly and slowly, and, at the same time, rise gradually, whereby the same part never comes under the action of the flame twice. (See plate, 3 fig. 5.)

A B C is an upright shaft, upon the upper end of which the cylinder of lime A is put; DE a grooved wheel to be driven by an endless screw, E, which endless screw has a cogged wheel FGH, which is driven by a spring having a train of wheels, the whole being regulated by a fly. The screw B is for the purpose of raising the shaft A B C when turning. By this screw the shaft A B C is raised; one whole revolution raising it the distance of one thread on the screw; the grooved wheel D E slides freely upon the shaft by a sliding piece K, having a square hole in it fitting the shaft, and which causes the wheel to turn along with it. That the wheel D E may not rise or fall, a groove or slit is made in K, which runs in a piece of board L H, fastened to the lower board.—*Mechanic's Magazine.*

W. ETTRICK.

STRAINING DRAWING-PAPERS.

Sir,—Perhaps the following methods of straining paper for drawings, without cements, may be useful to some of your readers:—(See plate 3, figs. 1, 2, 3, 4.)

Fig. 1 is a plan of the drawing-board, with four grooves *a b c d* cut round it, in which four slips of wood fit, as shown in fig. 2, which is a section through one of the grooves. The damp paper is to be laid on the board and tucked into the grooves. The slips of wood are then to be put into the position shown at fig. 2, along the whole side at once, and then pressed down into the grooves, as in fig. 3. It will be seen that the more the paper strains, the more firmly it will be held.

I have had a board made as above for antiquarian paper, and find the plan to answer in practice. There is a little difficulty in putting the slips into their places, which may be very much lessened by the grooves and slips being made perfectly straight and parallel; or it may be entirely removed by the contrivance seen in fig. 4.

a b is one of the grooves; *c c* the slip of wood, much narrower than the groove, so that it can be laid in its place, and forced tight up by the wedges *w w*. The empty parts of the grooves may serve to prevent the instruments rolling off the board.

Yours, &c.,
JAMES HENNELL.

June 4, 1836. *Ibid.*

NOTES AND NOTICES.

OIL FROM FLIES.—A society has been formed in Germany to extract *oil from flies*, for greasing wheels!*—*Cambrian.*

AEROSTATION.—A balloon is being constructed, under the direction of Mr. Green, of such dimensions as to be capable of carrying 10 persons. The gores of silk by which it will be formed are nearly 100 feet in length, the centre being about 4 feet in width, and verging at the extremity to nearly a point. When finished, the balloon will be about 70 feet high. It is made of the best manufactured silk. The net, which will surround it weighs 3 cwt., while the whole apparatus,

* *Fly*-wheels, I suppose.—*Printer's Devil.*

including net, but without gas, ballast, or passengers, will weigh about 7 cwt.

IMPROVEMENTS AND EMBELLISHMENTS IN PARIS.—The granite for the pedestal of the obelisk of Luxor has arrived, and only awaits the decrease of the waters of the Seine to be landed. It consists of seven blocks, one of which weighs 120,000lbs. The Hotel Dieu, it is said, will shortly be taken down, to carry on the beautiful line of quays which extend along each bank of the Seine. The sick will be removed to the Invalides, which establishment will be broken up, and formed into several branches, in various parts of the country, where articles of provision, &c. are cheap.—*Paris Advertiser.*

BRITISH MUSEUM BUILDINGS.—With the exception of the interior finishings, the northern side of the British Museum is completed: and when the interior of this part is finished, the temporary communication on the western side to the Elgin, Marble room, &c. will be removed, and made to correspond with the eastern side. It will be a few years before the old southern front, and the buildings round the entrance court-yard are taken down; but when they are removed, and the new buildings completed, the British Museum will be one of the most elegant architectural edifices, in the Grecian style of architecture, in the metropolis. The architect to the new buildings is Sir Robert Smirke.—*Architectural Magazine for July.*

APPLICATION OF STEAM-POWER TO THE CULTIVATION OF LAND.

Sir,—During the last twenty years steam-ploughs have been frequently on the *tapis*, and perhaps ere long we shall see them going about and undertaking to plough fields for whoever may desire their assistance, and with very little more preparation than is now required to place a portable thrashing-mill. About the time that the Leeds Railway was done, when high-pressure engines were much improved, the idea of thrashing by steam led me to think of making a portable plough, applicable to all kinds of land. Now that public companies are forming that will require the use of such things, perhaps my old plan may be useful to some of them. I send you, therefore, a description of it, that you may publish it as soon as convenient.

The sketch (see plate. 3, fig. 6.) shows my arrangements, made long ago, both for ploughing and harrowing land by steam-power. AA represent a piece of land to be ploughed B, a carriage on small wheels (or rollers if the ground is soft), which carries the steam-engine to work the wheel C; D is another carriage, at the opposite end of the field, to carry another wheel E. On these two wheels I put an endless chain or rope FG, which, when worked by the steam-engine, will draw a plough H and harrow I in different directions; and when they arrive at the end, I cause both the carriages B and D to be moved the width of the furrow, either to the right or left, and reverse the motion of the engine to draw the plough and harrow back again. In place of an endless chain, a common one with cylinders will answer the same purpose, by using proper conducting pulleys on the opposite carriage. To mention any smaller details, I presume, is useless.

I am, Sir,
Your obedient servant,
J. DICKSON, C. E.

9, Charlotte-street, Blackfriars-road,
June, 1836.—*Mechanics' Magazine.*

STEAM VERSUS WATER.

(From the *American Mechanic's Magazine.*)

Few persons, even in this age of inquiry and improvement, seem to be aware of the vast superiority of steam over every other form of motive power. Many are still, by this assertion, reminded of the anecdote of the famous Brindley. In giving evidence before a Committee of the House of Commons on the subject of Canals, he spoke of their superiority as a mode of communication in such decided terms, that a member asked for what he thought rivers were intended? he unhesitatingly replied, "*to feed canals.*" Now, though we say that the manufacture will one day "feed his boiler from the falls," we think that the assertion is not a bold one, and that it does admit of proof.

Some time ago, our attention was directed to a comparison of the expense of the two forms of power in the village of Lowell, possessed of the best water power in the Union. The expense of steam to water was said to be as 100 to 125.

We have since often had this subject in mind, in reference to the more improved use of steam, and particularly to the economy of the rotary-engine of Avery.

Pursuing the comparison, we have collected some of the more prominent disadvantages, of the usual hydraulic system, and the corresponding advantage of steam-power.

The first item of cost is that of the water-wright, over and above the value of the ground as increased by any other advantages of locality. This expense is in no case trifling, and sometimes is positively enormous. There is, of course, no corresponding item of expenditure in the use of steam, an engine working as well on the top of a hill as in the bottom of a valley.

2d. The outlay upon wheels, dams, and other hydraulic works. This is often much greater than would be necessary for the average pressure, provided it were constant—that is, we are to erect works to support much more water than we have supplied through three quarters of the year. Freshets, &c. are to be provided against, at an increased cost. It is well known that in some locations the provision for such contingencies is no small portion of the whole capital employed.

It is this expense, other things being equal, that is to be compared with the cost of an engine, and the comparison is favourable to the latter.

3d. After every precaution, damages from floods are of constant occurrence, and their repair is exceedingly costly.

4th. The delay caused by freshets, &c producing a stoppage from the too great supply of power.

5th. The delay in seasons of drought, when the supply is insufficient.

These last are most vexatious occurrences, preventing work oftentimes when most is to be done, and the uncertainty arising from the possibility of such delays and accidents, is a constant care to the manager of such an establisment; whereas to the consumer of steam, the perfect certainty of the amount and regularity of the supply of power is a great auxiliary in conducting business.

For a steam-engine, the only use of water is a sufficiency for the boiler ; and in these days of economy of heat and steam, a very small quantity of fuel is used, and but little water. We have seen a rotary engine, estimated at 15-horse power, evaporating but 40 gallons per hour.

6th. Delay in winter, and in our uncertain climate this may sometimes be considerable, and, in an establishment of great extent, perhaps fatal.

To balance all these expenses, peculiar to the use of hydraulic power, there is, as far as we can recollect, but one peculiar to that of steam, namely, *fuel*. Now, in saw-mills this expense is nothing, and in all instances much less than formerly.

Our persevering countryman, Dr. Nott, has already succeeded in greatly reducing this item of cost—and he does not yet appear to be satisfied.

As regards fuel, Avery's engine has immense advantages over others, inasmuch as the quantity of water used is less than in any other case. The elasticity of the steam operates more advantageously than in any other construction, the small quantity of water used being a proof of this.

In the engine above referred to, the cost for coal was rather less than one dollar for ten hours.

It is almost needless to observe that, in many large establishments, manufactories, &c., the application of a portion of the steam to heating, &c., nearly, if not quite, compensates the cost of fuel. The certainty and uniformity of this method of drying goods have fully established its superiority. Indeed, in the art of dyeing, certain colours owe their brilliancy to the rapid and high heat of steam, and they could be produced in no other way. While speaking of this use of steam, we must notice an engine erected in the Astor Hotel. This is a small engine of 5-horse power; its use is to pump water from the different cisterns to all parts of the house—supply the baths with hot and cold water—clean knives—brush shoes—roast and grind coffee; and the steam cooks the various dishes in the kitchen, and also dries the clothes, which by this method of proceeding are ready for use with unprecedented dispatch.

To these and numberless other uses is this engine turned, saving an immense number of servants, a great quantity of fuel, and a vast deal of time.

(The exhaust steam-pipe of this engine is over 320 feet long.)

One of the greatest advantages of steam-power, in many cases, is, that it admits of change of locality, without injury to the machinery, and often with benefit to the employer.

In this respect, again, Avery's engine stands pre-eminent. The machinery is beautifully compact, and consequently portable. An engine of 15-horse power is hardly a load for a horse, the whole weighing less than 600lbs.

Let us suppose, that a man purchases a piece of timber land, of prime quality, but, unfortunately (as is thought), away from any water-course.

Let him procure an Avery's engine ; and this, connected with his saw-mill, can be placed upon wheels and moved, by the engine itself, if he pleases, to any part of his land. (Mills capable of such an arrangement, and very compact, are now easily to be procured.)

Let him locate his mill near a spring, and commence operations. The waste and rubbish, that in most cases is a drug, is entirely consumed by the engine ; the ground is cleared, and nothing is to be removed but the perfectly formed timber.

Among other useful applications of such an engine, in the forest itself, no one can be equal in beauty of operation to the valuable stave-machine of Philip Cornell, N. Y. This machine promises to be of great service. With such an arrangement as that of the saw-mill above mentioned, nearly, if not quite, double the usual number of staves can be cut from the timber before transportation, and these are already dressed and ready for use, either for liquids or solids.

These are only a few of the very many useful applications of this sort of travelling machines. Others will suggest themselves to our readers.

It must be very evident that, whatever brings into use property of little or no value, enabling the produce of such land to compete successfully with that of much better, must add to the wealth of the landholder, or timber-merchant, a sum equal to the cost of the best land.

Thus a great uniformity of value would result, and of consequence a more equal competency to those on, or away from, great water-courses and canals.

MARBLE CEMENT.

An important improvement, which has been for several years in progress is about being introduced to the more general notice of the public, and, we believe, into extensive use for building purposes. It is a composition or cement, of which the principal ingredient is marble or lime stone, which, when applied to the inner or outer walls of buildings, presents the appearance of polished marble, of the various hues and qualities which distinguish the beautiful material imitated. What would be thought of a magician who possessed the power of changing the sombre brick and stone walls of the buildings of a city, in one week,

into substances, resembling the most beautiful Grecian, Italian, Egyptian, or Verd Antique marble, or porphyry, like the rock of Gibraltar! Yet all this may be done by this invention of a humble citizen, of Orange county, in this State. This cement has been sufficiently tested by experiments on buildings, to satisfy practical men of its decided superiority over any other cement, stucco, or other hard finish for walls, hitherto known. In our next Number we expect to be able to furnish the public with some interesting particulars on this subject; and in the mean time we can state, that a Company has been formed in this city to carry on the operations connected with the manufacture of this new cement, and its application to buildings.—*New York Railroad Journal.*

ORGAN.—The city of Munich has lately purchased a curious organ of marvellous effect. The pipes and stops are of a miniature size, yet have all the musical effect of a church organ. It is the work of an humble artist of Florence, named Michael Paoli; whose talent has been revealed for chance, and who, at the age of sixteen, made a beautiful clock, after one inspection of a model. The curate of his village first employed him to make an organ which all Florence admired.—*Athenæum.*

ROPE-MAKING MACHINERY.

Messrs. Macnab & Co. of Greenock, have published an Exposition of the Principles of Mr. James Lang's invention for Spinning Hemp into Rope-yarns by machinery, and its effect on the strength and durability of Cordage. Of this Exposition the following extract will convey an outline.

"It was only towards the end of the 18th century that the art of Rope-making engaged the attention of scientific men, and began to be conducted on scientific principles. Then it was discovered, that, by the mode of operation formerly in use, the yarns could not be brought to bear equally with each other; and, therefore, that a great loss of strength in the rope behoved to be the consequence. Great exertions were accordingly made by several intelligent individuals to remedy this defect, and between the years 1783 and 1807, no fewer than twenty-two patents were taken put for improvements in the art, and for machines of various descriptions,—these it is not to our purpose to describe. It may be sufficient to state, that the one invented by Captain Huddart of London, was greatly approved of, and obtained the highest celebrity. This plan was introduced into Greenock in 1802, by the late firm of Messrs. John Laird & Co., but was in some measure superseded a few years after by the method now in use, and which, by the application of the same principle, but of a more simple construction, was found to secure the same object, while, at the same time, it was better adapted for general purposes. For this improvement on Captain Huddart's plan we believe we are indebted to Mr. W. Chapman of Newcastle. The principle by which an increase of strength in the Cordage was effected (amounting to about 30 per cent.), is simply by so constructing the strand of the rope as that *every yarn is made to bear its own proportion of the strain.* That the application of such a principle should be followed by such a result, must be apparent to every one, and *it is by carrying out this same principle to its full length,* as we shall afterwards show, that we have been enabled to effect an additional increase of strength, and, consequently, of durability to the rope.

"That a great improvement in rope-making was effected by these gentlemen, there can be no question, but that perfection in the art might be attained, it was still necessary that the mode of preparing the yarns should also be improved. The usual process of hand-spining was considered very defective, as evidently it did not impart to the yarns that degree of strength which it was thought the material was capable of affording. Endeavours were accordingly made to obviate this defect also. Three patents were even taken out for machines, but these were found not to answer expectation; those constructed by Mr. Chapman are still used by some houses in England, but as they are very defective, they have never been introduced into general practice. A moment's consideration must be sufficient to convince any person, the least conversant in rope-making, that, if the strength and durability of the rope depend on the proper arrangement and equal bearing with each other of the yarns in the strand, so its strength and durability must also depend on the just arrangement, regular twisting, and consequent equal bearing of the fibrous substances which are employed in the composition of the yarns. Indeed, after the improvement above alluded to, this was the only thing requisite to complete the scientific construction of cordage; and by the application of machinery, on a principle somwhat analogous to that which we have already referred to, this desideratum has also been supplied. Mr. Lang, who had for many years directed his attention to the subject, and was convinced of its practicability, upon taking the active management of our works, got a set of machines constructed under his own direction, which, on repeated trial, were found completely to accomplish the object. By this invention, the regular spinning of the yarns, which had hitherto been prepared in a tedious and clumsy manner by hand-

labour, is one object which has been effected; but this, although in itself important, is one of its least advantages. By the same plan, the hemp, to whatever purpose applied, being drawn over a succession of gills, or small hackles, is dressed in the highest degree; hence the fibrous substances of the hemp are regularly split and subdivided; they are also multiplied to such an extent as that their number in a Patent-spun yarn will be found more than double the quantity of those which compose a hand-spun yarn of equal grist; this, every one will admit, must increase its strength in no inconsiderable degree. Again, while the fibres are thus greatly multiplied, they are also completely elongated and laid straight, so as to admit of being regularly twisted, and each fibre being stretched its full length and laid parallel to the others in the yarn, they are all made to bear at the same time, and equally, in the strain; thus every fibre of the hemp is called into action, and contributes its own proportion of strength to the fabric; this is certainly a most important feature in our Patent plan, and such a result could never be expected from the most careful and best conducted hand-spinning. But this is not all, by hand-labour the hemp can only be spun from the middle, or *bight;* and therefore only one-half of the length of its fibre is extended in the yarn, consequently, some qualities of hemp have hitherto been considered inferior, because, on account of the shortness of their fibre, they would not admit of being doubled: thus, a material in other respects as good, while of lower price, has been rejected in the manufacture of Cordage, not so much on its own account, but because, by the process of hand-spinning, only the one-half of its length could be employed. Now, Mr. Lang's plan has this additional advantage, that the hemp is spun by the end of the fibre, and thus, by having its whole length extended in the yarn, those qualities of hemp hitherto considered inferior, because shorter, may be applied with equal safety and advantage, and do in reality produce Cordage as strong and as durable as the others. When we take into account the very depressed state of this branch of our manufacture, in consequence of the facilities enjoyed by our neighbours on the continent of underselling us in a foreign market, as also the present state of the shipping interest, it will, by every candid person, be acknowledged that an invention such as this, by which we are enabled to produce a superior article, and at a cheaper rate, ought, even in a political point of view, to be regarded as a public good; and is consequently entitled to public encouragement and support."

Professor Jameson adds:—We have seen the rope-yarns, understand the machinery employed, have read carefully the exposition, and do not hesitate to say, that this new cordage has answered the expectation of those who have tried it, and that severely too, in many seas.*—*Arcana of Science.*

CYLINDER BEDSTEAD.

An important and invaluable contrivance, denominated the reclining cylinder bedstead, for which a patent has been recently obtained, and which, on the point of adoption in St. George's Hospital, London, has been minutely inspected and most cordially approved by *written* testimonials, by the whole of his Majesty's physicians and surgeons, and the most eminent practitioners in the metropolis, is one amidst the many brilliant evidences of that astonishing progress in mechanical science for which the present age is remarkable. The inventor is Mr. James Cherry, of Coventry.

The sacking is attached to two cylinders running lengthwise, one on each side of the bed; these cylinders contain several springs upon the chronometer principle, which propel them upon the axles outwards, or right and left from the centre of the bed. The sacking, when the bed is not in use, is always at full stretch; but when it receives the weight of the body, the springs relax, and the bedding is sunk to a concave of twelve inches; the feathers encompassing the patient and relieving the back from the pressure which is imparted to the sides; together with the undulating motion of the springs by which the bedding is sustained, impart a sensation of entire comfort and ease. In the opinion of the faculty, this individual feature presents an effectual preventive of *sloughing* in the back, that dreadful and often fatal consequence of a long continuance in the recumbent posture. The invalid, however helpless he may be, may be placed in any required position, either for his own comfort, or for surgical operation; for example, the body can be raised to any degree; the lower limbs placed on a double inclined plane, a point essential in the reduction of fractures; the feet elevated to assist in replacing a dislocated knee-pan, &c. &c.

By this fortunate invention, the torture which many patients experience from being lifted out of bed, and exposed to the atmosphere while the bed is re-making, or other necessary changes effecting, will be utterly obviated, and the expensive attendance of assistants precluded. *One person* can, in the space of two minutes, and without trouble or exertion, *complete an entire change of bedding* —the bed under the patient, bolsters, pil-

* Jameson's Journal, No. 56.

lows, &c. all may be swept upon the floor, and replaced by others, and this arrangement is made without inconvenience to the patient, nor is he in this, or any of the other changes, once touched or exposed to sight or cold.

The bedstead is also convertible into an *easy chair*, and can be restored to its horizontal without disturbing the patient or deranging the bed clothes; the bed-rest and pan are brought into use upon a new and most easy principle; the latter is closed by an air-tight, self-acting valve, and all its operations are conducted without the least noise or jarring from the machinery, which is entirely concealed when the bed is made up.

The revolving cylinder bedstead is an elegant structure, in the newest French style, with scroll back and canopy top, that it is not only applicable to cases of sickness, but available for ordinary use, imparting, from its peculiar construction, much greater comfort, with a mere mattress, than is derived from a bed of the softest down when laid upon a bedstead of the general description; in short, it fully justifies the patronage of the most eminent of the faculty, possessing every conceivable convenience, unimpaired by a single objection.*—*Ibid.*

HEBERT'S PATENT FLOUR-MAKING MACHINE.

From a personal inspection of the machine delineated in perspective on the preceding page, and from a careful perusal of the inventor's specification, it appears to us to be his design to construct flour-mills of the utmost simplicity and durabillity; in which, not only the *grinding* of the corn, but the *dressing* (sifting) of the meal into flour, pollard, bran, &c., are simultaneously performed. It is not, however, to be understood that these combined operations are effected by the mere *annexation* of a dressing-machine to a mill, and driving them both together; for in such an arrangement there would be neither novelty nor economy. But the combined operations of grinding and dressing are in this new patent mechanism so simplified, and so intimate, that they are continuously going on, *upon one continuous surface*. The essential members of the machine are thereby reduced to only *two*! one stationary, the other rotative. This remarkable simplicity conduces to many advantages, which our mechanical readers will at once appreciate, without our entering upon the details. The inventor has shown in his specification, and has actually put into beneficial practice, several modifications of the principle so as to adapt the scale of their operations to any required magnitude. We have selected for the present article what the patentee denominates his patent *domestic* flour-maker, which is adapted to the manual force of one man; but the power requisite to work this may be diminished or increased at the pleasure of the operator, by a corresponding reduction or augmentation of the *feed*, or quantity of corn permitted to pass under the operation of the grinders in a given time. In a subsequent Number we purpose inserting a description of one of the same kind of machines, which is in use at the workhouse of All Saints near Hertford, where it is worked by any number of men, from two to ten (by a suitable alteration of the feed), and is capable of properly grinding and dressing as much corn in a given time as other mills will grind only the estimated power required to work it efficiently, being that of one horse, whether worked by that animal, or by wind, water, or steam.

We shall now proceed to describe the hand-mill with reference to the engraving before adverted to.* (See plate 3, fig. 7.)

a is an axis, mounted in plummer-blocks *bb*, and turned by a winch *c*, assisted, if required, by a handle *d*, fixed to one of the arms of the fly-wheel *ee*. The axis *a* also carries a bevelled wheel, *f*, which drives a pinion *g* fixed upon a vertical spindle *h*, that revolves in the centre of a metallic hopper *i*, and carries at its lower extremity the upper grinder; and to the periphery of the latter is attached a series of brushes, that revolve together with it inside the circular case *j*, cast in one piece with the hopper *i*. The lower grinder is fixed in the centre of the flat top *k* of the pedestal; and around the lower grinder, in the same plane as its superior surface, is an annulus of fine wire-gauze; over the area of which the brushes sweep in their revolution, continually scattering every particle of the meal, as the same is constantly projected in minute quantities all around the peripheries of the grinders, on to the wire-work; causing the flour to fall through the meshes into the drawer *mm* below: while the bran and pollard, which cannot pass the wire-gauze, are continually being freed from their adhering flour by the action of the brushes, until they are driven through an aperture, at the outer circumference of the wire-gauze, on to an inclined screen of coarse wire-work, where the offal separates itself, in the mere act of falling, into pollard and bran; both of which deposit themselves into separate compartments made in the drawer *n*. At *l* is a screw for regulating the admission of the corn; and at *o* is a lever, over an engraved plate, which directs the operator which way to move it, according as he may desire to regulate the grinding, whether coarser or finer than it was previously set. These adjustments are obvious to the sight, and unerring in their action.

Amongst the advantages which this machine presents to the economist, may be stated its convenience, portability, and perfect cleanliness, and there being no dust or waste of

* Analyst, No. 10.

* Our draftsman, upon looking at this engraving, has observed to us, that he has made the square pedestal or box rather too small, which has given to the machine an appearance of top-heaviness, which the original does not possess.

any kind. It is particularly adapted for the use of domestic families who are desirous not merely to make their own bread, but to be sure that the flour which they use is a genuine product of good wheat. As respects its utility to emigrants and distant settlers, we have reason to believe that its merits have already been very satisfactorily tested, the durability of the grinding surfaces being such as to render a renewal of them apparently unnecessary for a series of years. A mill of this kind may be seen at No. 20, Paternoster-row.—*Mechanic's Magazine.*

PRESERVING PASTE.

Paste made by putting acetate, or sugar of lead, into it, instead of the old way of mixing it with alum, keeps it from moulding, and quite moist for months together.—*New Monthly Magazine.*

NEW LAMP.

A lamp of a new construction, which describes a circle of light of about thirty feet in diameter of the apparent intensity of sunshine, showing the objects within its sphere as distinctly as those on the table of a camera-obscura, has been erected at the head of the inclined plane in St. Leonard's depôt. Its object is to enable the engine-men to have a distinct view of the inclined ropes during the night, and this has been fully attained. The lamp consists of an argand burner placed in the focus of a large speculum of a peculiar form, by which the whole light is distributed just on the space where it is required; it is computed that the light on the above space is equal to that of twenty-five or thirty similar burners in common lamps. A lamp of this kind we have no doubt would be useful for other purposes: it appears to us that the largest assembly room might be brilliantly lighted by one placed at each end of the room, and one would be sufficient to light the stage of a theatre. The cost of this one is said to be about 200*l*., but we understand it saves an annual expense of about half that sum. The inventor is a Mr. Rankin, and he names it the Conoidal lamp—probably because the light is thrown from it in the form of a cone.—*Caledonian Mercury.*

CURRENTS IN WATER.

In this last number of *Silliman's Journal*, in an article on "currents in water," it is asserted, that if a tub or other vessel is filled with water, and a hole made near the middle of the bottom of it to discharge it, the water will acquire a rotatory motion from west to south, or opposed to the apparent motion of the sun; and if means are used to produce an opposite motion, upon withdrawing those means the former direction will be resumed. This cannot be the effect of chance, but of natural laws constantly operating.—*Guernsey Star.*

HOUSEHOLD MANUFACTURE OF SUGAR.

A remarkable proof of the facility with which beet root sugar manufactories may be established is presented at this moment at Wallers, in the department du Nord. Four of the villagers, by advancing 50 francs each, have formed a joint capital of 200 francs, and with this they produced between 40 and 50 lbs. of sugar, of rather inferior quality, a-day. They employ curry combs to rasp the beet roots, which they put into a napkin-press to extract the juice, and then boil the syrup in common culinary boilers.—*Ibid.*

NEW SHIPS' SIGNAL LANTERN.

A most admirable invention has recently been brought into use, and is likely to meet with general adoption, intended to prevent those accidents which are the cause of so much loss of property, as well as the annual sacrifice of a number of valuable lives. It consists of a ship's lantern, of copper, strongly and efficiently constructed, and possessing the means of being regulated so as to show a light of different colour, according to the tack upon which the vessel bearing it may be sailing, or the position in which she lies. A set of instructions accompanies each lantern, by which the master is informed what light he is to show on each change of tack and position, and thus a mutual understanding is attained amongst navigators as to the meaning of the signals exhibited. The changes of colours are effected by the following simple contrivance:—The lantern contains an interior case, capable of being turned round, and having windows of glass of several colours. The lamp of the lantern has a strong reflector and powerful "bull's eye," or magnifier, to project the light, opposite which, in the outer case, is an aperture. By turning round the interior case, each coloured glass window is brought in front of the bull's eye, and thus a light of the colour required is projected.—*Hull Packet.*

KEMP'S SUBMARINE APPARATUS.

We understand another attempt is about to be made to raise the hull of the *Cameleon*, by Mr. Kemp, who, having obtained a patent for the buoying principle, has received permission from Government to make an experiment on this ill-fated vessel, and in the event of its proving successul, the wreck as it may be raised will become the reward of the enterprise. Mr. Kemp's apparatus consists of a number of empty puncheons, each open at one end, and having a bar of iron across, by which, after being sunk, they are attached to a chain, previously passed round the wreck by the divers, who next employ themselves successively applying to each cask the elastic tube through which they are filled by the air-pump,

and the water consequently expelled. The puncheons thus charged with air acquire a perpendicular position, and are so buoyant as to render certain the raising of any weight proportionate to the number of them employed. The operation of filling the puncheons with air will be comparatively easy in this instance, as from the favourable circumstance of the wreck lying in less than thirteen fathoms of water, little more than two atmospheres will be required, and scarcely any doubts are entertained of the attempt proving successful.—*Dover Telegraph.*

MASSIE AND RANWELL'S PADDLE-WHEELS.

A few days ago, the first public trial of this new paddle-wheel for steam-vessels was made on the River. It was affixed to the Red Rover steamer, belonging to the Herne Bay Company, which conveyed the female emigrants and agricultural families to the ship at Gravesend in which they embarked for Van Dieman's Land. After the emigrants had left the steam-vessel, to the starboard side of which the new wheel was affixed, the larboard side being furnished with the common wheel, the Emigration Committee, visitors, and several naval officers, proceeded to inspect the new paddle-wheel, a model of which was submitted and familiarly explained by Mr. Massie and Mr. Ranwell. The principle seems to consist in the exposure of the entire surface of the float to the water while in the most advantageous position for propelling, which upon approaching the surface becomes divided into a series of angular bars, which suffer the water to pass through the interstices, and thus transfer the action of the steam-power to the next floats in succession, instead of uselessly wasting it on the water-lift. A considerable ferment in the water (though the swell was not so heavy) was apparent, which, however, a little alteration in the construction will considerably diminish, and which the experiment will enable the inventors to accomplish.—*Weekly Dispatch.*

COINS IN THE CLOUDS!

A Brighton physician lately adopted the following singular means of preserving some of the coins of the realm. He enclosed several of the last impressions in a ball of wax, which he placed in a balloon of India-rubber sufficiently inflated with gas to raise it several thousand feet above the earth, where, floating in space the memory of our nation and its monarch, may be recorded for hundreds of thousands of years. Within the ball of wax was also placed a slip of parchment with the following letters cut out:—"Anglia Martis X., 1836."—*Dispatch.*

ON CERTAIN IMPROVEMENTS IN THE CONSTRUCTION OF MAGNETO-ELECTRICAL MACHINES, AND ON THE USE OF CAOUTCHOUC FOR INSULATION IN VOLTAIC BATTERIES.

By Fred. W. Mullins, Esq., M.P., F. S. S.

To the Editors of the Philosophical Magazine and Journal.

Gentlemen,—I think it important to call the attention of the scientific readers of your valuable Journal, to some improvements recently made by me in the construction of the magneto-electric machine, which go far to demonstrate the still very imperfect state of these instruments, and form a foundation for alterations infinitely more important both in their mode of construction and application.

The machine whose power I had an opportunity of testing was constructed on the most approved principle, and consists of two sets of bar-magnets arranged vertically, each set consisting of a dozen bars, and the upper poles of one set being unconnected with those of the other. I had previously seen and examined horizontal horse-shoe machines, and, so far as I was enabled to institute a comparison, considered the other mode of construction to be preferable. After trial, however, it struck me that the power of all magneto-electric machines was very imperfectly developed, and that it might be possible to obtain considerably greater effects from the same number of magnetic bars by establishing a *magnetic* connexion between the poles of the latter, and this without much difficulty or increased expense. With this view I procured two magnetized arcs of the shape given in the annexed figure, and of the same width and thickness as the bars of the machine. (Plate 2. fig. 10.) I then applied them, one to the opposite poles of the *outside* pair of bars, and one to those of the *inside*, and on giving the shock to a gentleman who was present, and who had tried the power of the instrument when the poles were *unconnected*, the effect was so much increased that he refused to repeat it, and on trying it on myself I found the power to be fully double what it had previously been. I was aware that connecting pieces of soft iron were sometimes used, but that their utility was said to be very questionable, and having myself tried them, I can safely say that soft iron as a mode of connexion is useless; it is evident, therefore, that the increase of power does *not* depend upon connexion, *unless* when *the substance forming the connexion is in a peculiar state, and thereby capable of exerting a certain influence on the poles of each set of magnets,* which influence, it can be shown, does *not* depend upon the *size* of the connecting magnets, for I have tried large horse-shoe magnetic bars, single and in sets, without any

increase of power *beyond that* obtained from the small magnetic arcs represented in the figure.

Induction is certainly a cause, but not the *sole cause* of the increased power; there are other causes, as yet unexplained, which I trust may appear satisfactory to those who may peruse a paper which I am now preparing on this highly interesting subject: suffice it here to say, that in the future construction of the instruments in question, magnetic arcs in connexion with *vertical* bar-magnets should decidedly be used in preference to any other form or mode of construction at present known; and I would strongly advise any person who happens to have a machine of the horse-shoe form to cut off the bend as indicated in the annexed figure (Plate 2, fig. 11) and re-apply the same or other pieces of the same size magnetized, for by so doing it will be found that a vast increase of power will be obtained. I have thrown out these hints in the hope that they may lead to still greater improvements in the mode of developing the powers of combined magnets. In concluding this subject it may be well to observe that with my improved magnetic machine I have charged a Leyden jar, and obtained by the same means various others results similar to those obtained from the action of the common electrical machine.

In conclusion I would add, that in the various experiments I have made in regard to the best modes of developing and sustaining voltaic electricity, I have found that caoutchouc, or Indian-rubber, may be used with great advantage for insulation. I have applied it in place of glass in my intensity-sustaining battery; and as it can be made to adhere to the copper and may be laid on as thin as common letter-paper, a combination of plates or cylinders may be brought so close together as to occupy only a third of the space filled by a similar combination in the batteries at present used. In my intensity-battery, from the advantages derived from bringing the metallic cylinders as close as possible, this mode of insulation is most convenient and satisfactory.

I am, Gentlemen, yours, &c.
FRED. W. MULLINS.

House of Commons, July 1, 1836.

ON THE CAUSE OF THE REMARKABLE DIFFERENCE BETWEEN THE ATTRACTIONS OF A PERMANENT AND OF AN ELECTRO-MAGNET ON SOFT IRON AT A DISTANCE.

BY THE REV. WILLIAM RITCHIE, L. L. D., F. R. S.,

*Professor of Natural Philosophy in the Royal Institution and in the University of London.**

As soon as the electro-magnet was constructed and employed to illustrate the immense magnetic power communicated to soft iron, it must have been observed that its attraction for iron filings or pieces of soft iron *at a distance* was much less than that of a permanent magnet of equal *lifting* power. This peculiar property rendered the electro-magnet not well suited for magnetic induction at a distance; and hence, after a few unsuccessful trials to substitute it for the permanent magnet in my apparatus for continued rotation, it was long since abandoned. In a short paper by Mr. Rainey in the last Number of this Journal, p. 72, the fact is stated, and an explanation attempted to be given of this peculiarity; but I am afraid the explanation will not be found in accordance with the present state of the science. This subject having engaged my attention some years ago, I had several times commenced a paper intended for the Philosophical Magazine, but other more pressing subjects prevented me from finishing it. As the fact is a necessary consequence of the properties of electro-magnets which I formerly made public in your Journal, I take the liberty of sending you the present investigation, which may be regarded as the completion of my former paper.

Experiment 1. Suspend a piece of soft iron, C D, at the extremity of a slender delicate balance of light wood; place a permanent horse-shoe magnet below it, and ascertain its attractive force, by weights put into the scale G, when it is in contact, and also when it is removed to different distances from the soft iron. Remove the permanent magnet, and substitute a very *short* electro-magnet of equal lifting power. Remove it to the same distances as before, and the attractive power will diminish very rapidly compared with that of the permanent steel magnet. (See Plate 2, fig. 9).

Exp. 2. Instead of the short electro-magnet substitute a very long one (one of two or three feet long, for example,) and of equal carrying power; remove it to the same distances and ascertain its attractive power, and it will be found that its attraction for the lifter at these distances will *not* diminish so rapidly as that of the short one. The *longer* the electro-magnet becomes, the *more* does it approach to the character of the permanent magnet in all its properties.

Exp. 3. Instead of making the electro-magnet of *soft* iron, make it of *hard* iron or untempered steel; repeat the preceding experiments, and its attractive power at a distance compared with its lifting power will be much greater than in the case of the electro-magnet of soft iron.

These facts, which as far as I know, have not before been published, will enable us to account for this property on principles previously recognised. The perfect equality of *action* and *reaction* must be found to exist in this case as well as in every other in which *force* of any kind is concerned. The electricity which has been decomposed and arranged in the soft iron in the peculiar manner which constitutes magnetism, cannot decompose and arrange the electricity belonging to the lifter without suffering a corresponding *dimi-*

* Communicated by the Author.

nution, and the more difficult the arrangement in the lifter so much greater will be the diminution of power in the electro-magnet. Again, if the electricity in the electro-magnet be easily arranged by the induction of the voltaic helix, it will be easily forced back to its natural state by the *reaction* of that belonging to the lifter. Hence it follows that when the *inducing* power of the electro-magnet is very great (which it is when the lifter is in contact with its ends), it will possess sufficient power to *vanquish* the *coercitive* force of the lifter, arrange by induction a large portion of the electricity of the lifter, and thus exhibit powerful attraction. When the lifter is removed to a certain distance, one-tenth of an inch for example, the power of the electro-magnet being much *diminished* in consequence of the distance, whilst the difficulty of overcoming the coercitive force of the lifter is *increased*, the effect will be very small compared with the former. For, if the inducing power be only equal to the coercitive force of the lifter, no attraction whatever will take place; and hence the impossibility of magnetizing a large bar of steel tempered as hard as possible, by means of a small permanent magnet with a soft temper.

Now, if the coercitive force of the electro-magnet be increased, which is done either by employing a long magnet, or using hard iron or untempered steel, such a magnet will suffer a *less* diminution by the *reaction* of the lifter in the case of increased difficulty of arrangement in the lifter, than in the case of the short electro-magnet of perfectly soft iron.

In the case of the permanent magnet of tempered steel, the electricity belonging to it was arranged with *difficulty*, and after repeated *touches* of another magnet, and consequently it will easily vanquish the coercitive power of a piece of soft iron, and induce a magnetic state upon it, whilst the peculiar arrangement of its own electricity will remain nearly *unchanged*. Hence its *attractive* powers will diminish *nearly* as the squares of the distances of the soft iron from its poles, or *imaginary* centres of accumulation, a law which cannot exist in the case of the electro-magnet the electricity of which is so easily put in motion round the elementary molecules of the iron by the reaction of the lifter.

In the explanation given by Mr. Rainey the lifter is supposed to *react* powerfully on the electro-magnet so as to increase its power, a supposition which cannot possibly be admitted. For the electro-magnet must, in the first place, give the lifter *all* its magnetic power, consequently the power of the lifter never can *exceed* that of the electro-magnet, and consequently never can *induce* a higher magnetic state in it than what has already been done by the volatic helix.—*Phil. Mag. for Aug.* 1836.

THE

STUDY OF SCIENCE,

A FAMILIAR INTRODUCTION

TO THE

PRINCIPLES OF NATURAL PHILOSOPHY.

As, among our readers, there may be some who have not had opportunities of becoming acquainted with the recent elaborate researches and ingenious speculations of learned men in the several departments of Natural Philosophy, we have determined to devote a certain number of pages monthly, to form a series of lectures in the several branches of science, by way of a familiar introduction to the study of Natural Philosophy with modern discoveries.

GEOLOGY.

(*Continued from page* 349.)

The proper object and design of geology, therefore, must be the study of the general structure of what may be termed the shell of the terrestrial globe; for though speculations relative to the nature of the internal strata, or even the nucleus of the mass, are not wholly inadmissible, yet they must ever be regarded as of secondary importance, and should be no further pursued than they are warranted by those facts and appearances which come immediately under our observation. This consideration, however, was entirely lost sight of by those earlier writers, who either incidentally or professedly treated of the earth. It would be profitless labour to pursue at length the reveries of a host of bold theorists, who sprung up between the period of the rivival of learning in Europe and the middle of the last century; and whose systems of cosmogony, as they vainly styled them, have by more sober inquirers been justly stigmatized as romances, indebted for their existence to the prolific powers of imagination.

But while so many philosophers were busily employed in endeavouring to erect systems of cosmogony on the basis of their own most imperfect knowledge of the nature of mineral bodies, or drew their ephemeral theories solely from imagination, there were some who more wisely applied themselves to the observation of nature, and to the collection of correct information relative to the productions of the mineral kingdom in general, and especially concerning those fossils which exhibit traces of having originated from organization.

Bernard Palissy, a potter of Saintes towards the end of the sixteenth century, is said by Fontenelle to have been the first who ventured to assert in Paris, in opposition to the prevaling opinion, that petrified shells were the remains of testaceous animals that had formerly lived in the sea, and that all these were not deposited at the universal deluge. He wrote on the Origin of Springs from Rain-water, and other scientific works; and he had the merit of displaying much juster views of the operations of nature than most of his contemporaries, though his ideas met, in his own time, with a very faint reception. Similar notions were advocated by Nicholas Steno, a Dane, who became professor of anatomy at Padua in Italy, in 1669; and Hooke and Ray, in England, distinguished themselves by opposing facts to visionary theories.

Leibnitz, in his Protogæa, published in 1680, advanced the bold hypothesis, that the earth was originally a burning luminous mass, the gradual refrigeration of which produced the primitive rocks, forming at first a solid crust, and this being ruptured, owing to irregular contraction, the fragments fell into the universal ocean formed by the condensation of vapours on the surface of the globe. He proceeds to trace the production of inundations, convulsions, and attrition of solid matter, by its subsequent deposition constituting the various kinds of sedimentary or stratified rocks. Hence, he observes, may be conceived a double origin of primitive masses: (1.) By cooling after igneous fusion; (2.) By re-concretion from aqueous solution.* "Here," says Mr. Conybeare, "we have distinctly stated the great basis of every scientific classification of rock formations."† The grand feature of the theory propounded by Leibnitz, relative to the candescent state and gradual cooling of the earth, was adopted only by Whiston, but likewise more recently by Buffon, Deluc, and other theorists.

Among those men of science who contributed to the improvement of geology, by their researches into the actual structure of the earth's crust, was Tilias, a Swede; who, aware of the importance of an exact knowledge of mineral bodies, published in 1750 several topographical descriptions illustrative of the geology of certain districts in Sweden. He was followed by Lehman, a German mineralogist, director of mines in Prussia, who, in an Essay towards a Natural History of the Strata of the Earth, 1756, proposed a division of mountains into those formed before the creation of animals, and containing no fragments of other rocks; mountains which were derived from the partial destruction of the primary rocks by a general revolution; and those which resulted from local revolutions, and in part from the Noachian deluge.

Many other writers now appeared, who advantageously directed their attention to the investigation of particular topics connected with this subject; as the causes and phenomena of earthquakes and volcanos, the formation of deltas or low tracts at the mouths of rivers, the actual structure and position of the mineral strata, and the description of fossil remains of animal or vegetable origin. Among those who rendered important services to the cause of science by advancing general views of the theory of the earth, were Dr. James Hutton, of Edinburgh and Professor Werner, of Freyberg, in Saxony. These celebrated philosophers produced systems, in one respect, diametrically opposite to each other; for while Hutton attributed the formation of the older rocks entirely to the agency of fire, Werner insisted that they originated from solution in a liquid.

The German geologist deserves the credit of having directed the attention of his pupils to the constant relations of mineral groups, and their regular order of superposition; distinguishing the classes of primary rocks, or those destitute of organic remains, as granite and gneiss; transition or secondary rocks, formed from the disintegration of the preceding, and occasionally exhibiting traces of organic remains, as greywacke, a mechanical compound of agglutinated fragments; floetz or tertiary rocks, including the coal strata, chalk, and freestone, some of which abound in organic relics; and besides these, alluvial strata and volcanic rocks, the latter of which he seems to have regarded as of little importance, for he asserted that in the primeval ages of the world there were no volcanos.

The great merit of Hutton consists in his having demonstrated the igneous origin of basalt, and other trap rocks; the high probability that granite is derived from the same source; and that the other primary non-fossilliferous rocks have been more or less subjected to the agency of fire. "The ruins of an older world," said Hutton, "are visible in the present structure of our planet, and the strata which now compose our continents have been once beneath the sea, and were formed out of the waste of pre existing continents. The same forces are still destroying, by chemical decomposition or mechanical violence, even the hardest rocks, and transporting the materials to the sea, where they are spread out, and form strata analogous to those of more ancient date. Although loosely deposited along the bottom of the ocean, they become afterwards altered and consolidated by volcanic heat, and then heaved up, fractured, and contorted."*

The theory of Hutton was admirably illustrated and ably supported by Professor Playfair, of Edinburgh, while it was assailed

* "Unde jam duplex origo intelligitur primorum corporum, una, cum ab ignis fusione refrigescerent, altera, cum reconcrescerent ex solutione aquarum."

† Progress, Actual State, and Ulterior Prospects of Geological Science, in Report of British Association for 1832, p. 368.

* Lyell's Principles of Geology, 3d ed., 1834, vol. i. pp. 88, 89; from Hutton's Theory of the Earth.

by Murray, Kirwan, Deluc, and others, a violent controversy being maintained between the partizans of Werner, who were called Neptunists, as ascribing the formation of all rocks to water; and those of Hutton, styled Vulcanists, because they attributed the original formation of rocks to fire. The Neptunists, for a time, constituted by much the more numerous party; but in the course of these discussions, it was at length perceived that speculation had, on both sides, been carried further than was warranted by the extent of existing information; and that while neither the theory of Werner, nor that of Hutton, could be considered as affording an explanation of all the phenomena, or making near approaches to perfection, there were many points with respect to which the researches and observations of both these philosophers contributed to the extension of our knowledge, and the improvement of the science.

"A new school at last arose, who professed the strictest neutrality and the utmost indifference to the systems of Werner and Hutton, and who resolved diligently to devote their labours to observation. The reaction, provoked by the intemperance of the contending parties, now produced a tendency to extreme caution. Speculative views were discountenanced; and through fear of exposing themselves to the suspicion of a bias towards the dogmas of a party, some geologists became anxious to entertain no opinion whatever on the causes of phenomena, and were inclined to scepticism, even where the conclusions deducible from observed facts scarcely admitted of reasonable doubt.

"But although the reluctance to theorize was carried somewhat to excess, no measure could be more salutary at such a moment than a suspension of all attempts to form what were termed *theories of the earth*. A great body of new data was required, and the Geological Society of London, founded in 1807, conduced greatly to the attainment of this desirable end. To multiply and record observations, and patiently to await the result at some future period, was the object proposed by them; and it was their favourite maxim, that the time was not yet come for a general system of geology, but that all must be content for many years to be exclusively engaged in furnishing materials for future generalizations. By acting up to these principles with consistency, they in a few years disarmed all prejudice, and rescued the science from the imputation of being a dangerous, or at best but a visionary pursuit."*

One train of research, which was now pursued with great ardour, and which contributed much to the improvement of science, was respecting the nature of the organic remains, which were found imbedded in various strata in different parts of the world. Cuvier, the celebrated anatomist and zoologist, professor of natural history at Paris, acquired great distinction by the number, accuracy, and importance of the discoveries which he made relative to the generic and specific characters of the animals, fragments of whose bones, and other constituent parts, occurred to notice in the course of his long and laborious investigations. He ascertained that numerous living beings of different classes, which have no existing analogues, once inhabited the surface of the globe; and that the relative priority of the several strata might, to a certain extent, be inferred from the characters of the organic remains included in them.

Among the recent cultivators of this branch of science besides Cuvier, may be named Alex. Brogniart, Lamouroux, Lamarck, Deshayes, Marcel de Serres, Brocchi, Goldfuss, Parkinson, Buckland, Conybeare, J. S. Miller, Mantell, Lonsdale, Say, Morton, and Harlan, who devoted their attention chiefly to fossilized animal remains; and Adolphe Brogniart, Witham, Lindley, and W. Hutton, whose investigations have been especially directed to botanical oryctology. The results of their researches relative to these subjects, and those of other geologists concerning the mineralogical structure and position of rocks and mountains, and the modifying influence of existing causes on the surface of the earth, have greatly contributed to the augmentation of our knowledge of the nature and arrangement of the superficial strata of the planet on which we dwell, which must be regarded as the only sure foundation of a true system of geognosy, which may verify or overturn the conjectural speculations of those philosophers who wrote during the infancy of the science.

"When we compare the result of observations in the last thirty years, with those of the three preceding centuries, we cannot but look forward with the most sanguine expectations to the degree of excellence to which geology may be carried, even by the labours of the present generation. Never, perhaps, did any science, with the exception of astronomy, unfold, in an equally brief period, so many novel and unexpected truths, and overturn so many preconceived opinions. The senses had for ages declared the earth to be at rest, until the astronomer taught that it was carried through space with inconceivable rapidity. In like manner was the surface of this planet regarded as having remained unaltered since its creation, until the geologist proved that it had been the theatre of reiterated change, and was still the subject of slow but never-ending fluctuations.

This discovery of other systems in the boundless regions of space was the triumph of astronomy;—to trace the same system through various transformations—to behold it at successive eras adorned with different hills and velleys, lakes and seas, and peopled with new inhabitants, was the delightful meed of geological research. By the geometer were measured the regions of space, and the relative distances of the heavenly bodies;—by the geologist myriads of ages were reckoned, not by arithmetical compu-

* Lyell's Principles of Geology, vol. i. pp. 102, 103.

tation, but by a train of physical events—a succession of phenomena in the animate and inanimate worlds—signs which convey to our minds more definite ideas than figures can do, of the immensity of time.''*

"By the discoveries of a new science, (the very name of which has been but a few years ingrafted on our language,) we learn that the manifestations of God's power on earth have not been limited to the few thousand years of man's existence. The geologist tells us, by the clearest interpretation of the phenomena which his labours have brought to light, that our globe has been subject to vast physical revolutions. He counts his time not by celestial cycles, but by an index which he has found in the solid framework of the globe itself He sees a long succession of monuments, each of which may have required a thousand ages for its elaboration. He arranges them in chronological order, observes on them the marks of skill and wisdom, and finds within them *the tombs of the ancient inhabitants of the earth.* He finds strange and unlooked-for changes in the forms and fashions of organic life during each of the long periods he thus contemplates. He traces these changes backwards through each successive era, till he reaches a time when the monuments lose all symmetry, and the types of organic life are no longer seen. He has then entered on the dark age of nature's history; and he closes the old chapter of her records. This account has so much of what is exactly true, that it hardly deserves the name of figurative description."†

(To be continued.)

ELECTRICAL THEORY OF THE UNIVERSE.

By Mr. Thomas S. Mackintosh.

(*Continued from page* 359.)

In the concluding part of our last paper we remarked, that in treating of the moon's approximation we should be enabled to draw our arguments and inferences from two sources, astronomy and geology. Let us examine, in the first place, what support our theory derives from astronomy. We have laid it down, that if two or more comets settle into the planetary state about the same period, the larger attracts the smaller to its sphere, and these become its secondaries. Now, a slight glance at the planetarium, or a scheme of the planets, will at once convince us of the extreme probability of this assumption. Here we see the planets and satellites in the following order and proportion ; the number of moons are found in regular gradation, corresponding with the age of each planet, with only one exception, but even this disappears when viewed in connexion with the other parts of our theory ; this exception is Mars, and the asteroids or minor planets. Mars has no satellite : and the asteroids, which are no larger than satellites, and appear, from their situation, as if they ought to have been attached to Mars, revolve in orbits round the sun like the primary planets. According to our hypothesis, this exception to the general rule admits of an easy explication. From the relative situations of Mars and the asteroids, the former appears to have settled at a period too remote to admit of the latter coming within the sphere of his attraction ; nor are they, from their equal magnitudes, capable of attracting each other. If we allow this explication, the whole series will stand as follows, taking Mars and the asteroids as a planet and his satellites :—

Primaries.	Distance from Sun in Miles.		No. of Moons.
Mercury....	36 000,000.................		0
Venus.....	68,000,000.................		0
Earth......	95,000 000....		1
Mars	144 000,000....	asteroids....	4
Jupiter	494 000 000.................		4
Saturn	906,000,000.................		7
Uranus.. ..	1822,000,000.................		6

Had the minor planets been attached as satellites to Mars, it is probable, judging by his distance from the sun as compared with the earth and Jupiter, we should not at this time have found more than two remaining. We should also remark, that it is by no means improbable that Mars was attended by one or two satellites during the early stage of his planetary existence. It is further to be remarked, that Uranus, the most distant, and, according to our theory, the most recent of all the known planets, is represented as having only six satellites to accompany her, being one less than Saturn. But this number only represents the satellites of Uranus that have been discovered hitherto. Astronomers are agreed, that, with more powerful instruments, it is extremely probable that several more might be discovered. Upon the whole, we are satisfied, if this table be considered attentively, in conjunction with the foregoing hypothesis, that the truth, or extreme probability of our theory, is a conclusion that must press itself very closely upon the mind.

In the older astronomical works we find the moon's mean distance from the earth set down at 240 000 miles ; whilst in the more recent works it is valued at 235,000. It is said that this difference has arisen from the imperfect means of observation possessed by the early astronomers ; and that the moderns, with more correct instruments and improved modes of observation, have been enabled to calculate the mean distance with more accuracy, and that, therefore, the modern calculation is a much nearer approximation to the truth. To a certain extent this may be the case ; but when we consider that Thales, the philosopher, was enabled to calculate and foretell an eclipse 600 years before Christ, it would appear that the ancients had a more extended knowledge of astronomical science than is generally conceded them by the moderns. It is inconceivable that the early astronomers, excelling as they did in mathematical knowledge, should, in computing the moon's mean distance, have committed an error amounting

* Lyell's Principles of Geology, vol. i. pp. 106, 107.

† Discourse on the Studies of the University, by Adam Sedgwick, M. A F. R. S., Woodwardian Professor, and Fellow of Trinity College, Cambridge, 1834, pp. 25, 26

to a 48th part of the whole value ; especially when it is considered that the moon's distance, astronomically speaking, is comparatively small, and might be ascertained with tolerable accuracy, by observations on her horizontal parallax.

We are, therefore, induced to conclude, that this difference has arisen, to a certain extent, from the moon's approximation. If we had a true and invariable standard of time to which we could refer, it might possibly furnish us with a datum whereby to determine the rate of the moon's approximation. According to our theory, the moon's rate of motion in her orbit is a continually increasing quantity, and the mean time from node to node is, consequently, continually decreasing. But as the earth is also subject to the same laws, it is evident that her motions and time must also vary in a direct ratio with those of the moon ; and, therefore, a true measure of the duration of time cannot be obtained by assuming as a standard the period of the earth's annual revolution, or that of the moon, or, indeed, of any *single* planet in the solar system. If the true time of *all* the planets were carefully ascertained and compared with each other, we might obtain a *mean time* that should approach very nearly to the truth. But perhaps the only true and unvarying standard of time in the solar system is to be derived from the sun's rotation on his axis, as, from his situation in the centre of the system, he is not affected by the same causes, it is probable that his rotary motion is uniform and constant.

It would appear, also, that even the motions of the earth, as compared with each other, are not constant and uniform ; that the velocity in her orbit is increasing, whilst the diurnal motion remains stationary, or perhaps, agreeable to our theory, we ought to say, that the latter suffers a retardation. In the time of Julius Cæsar, the length of the year was settled at 365 days and 6 hours ; and in the time of Pope Gregory XIII., in 1582, it was found that the equinox had gone backwards 10 days, in consequence, as it was supposed, of the year having been fixed at too great a length ; it was, therefore, determined that the calendar should be reformed, and the length of the year was settled at 365 days, 5 hours, 48 minutes, and 51·6 seconds. This was done by the ablest men in Europe with great care and circumspection, and after extending their observations throughout a long series of years ; and yet it has lately been discovered, as appears in Dr. Playfair's "System of Chronology," that the Gregorian year is too long. As usual, this discrepancy is attributed to the reformers of the calendar, and no one seems to suspect, that the year is gradually becoming shorter. It may be objected, that the difference is extremely small as compared with so long a period. But we must recollect, that all the works of nature are carried forward by slow, sure, and imperceptible degrees ; and, therefore, the smallness of the difference only shows, that this work is in strict comformity with all her other operations.

Our theory assumes, that the planets and satellites are maintained at their respective distances from the sun and each other by the relative quantities of positive and negative electricity with which each is charged, or, in other words, by the solid contents of matter contained in each, and the quantity of electric fluid with which that matter is charged or saturated. Now, as we can determine by experiment the exact state of two electrified bodies by the attractive and repulsive forces which they exert on each other—and we know that these forces follow the same law as to the intensity of the fluid, namely, the inverse ratio of the square of the distance—this might furnish us with a rough datum for ascertaining the moon's electrical state, that is, how far she has receded towards a complete negative condition ; and as the power which she exerts upon the tides is governed by the same law that regulates her own distance, we might, by carefully estimating the *difference* of her attractive and repulsive forces in apogee and perigee, be enabled to obtain a tolerably correct measure of his inductive influence. The ocean may be regarded as a great natural barometer, indicating the state of the electrical atmosphere by which the earth is surrounded ; but as it is moved by three forces at the same time—the moon, the sun, and the earth's galvanic circle—all these elements of power must be nicely adjusted before we can expect to arrive at any thing like an accurate calculation.

(To be continued.)

ELECTRO-VEGETATION.

By T. Pine, Esq.

Whatever opinion may be formed respecting the identity of the fluid which emanates from the sun, and that which is the cause of electricity, *the principle of the extraordinary conducting virtues of plants through their acute extremities will, I trust, be admitted from the facts which are there adduced.* I have alluded to some other facts and experiments, tending to show that this conducting virtue is intimately connected with their vegetating properties. In connexion with this most energetic influence continually exerted by plants, it appears to be of the greatest consequence to determine how far they are furnished with supplies of the electric fluid in the medium by which they are surrounded ; and at what seasons, and under what circumstances, this supply appears to be most abundant in the ordinary course of nature. With a view to a satisfactory answer to this question, I turned my attention to the observations of those electricians who have made numerous experiments on atmospheric electricity, and in particular to those of Mr. Cavallo, from the second volume of whose work on electricity

I have deduced the following particulars:—The electricity of the air, as distinguished from that of clouds and storms, was not the object of his researches, till it incidentally fell under his observation in the course of his experiments with the view to the latter object. But he soon discovered, contrary to his expectations, that a clear atmosphere was attended with a constant positive electricity; while a generally clouded atmosphere either afforded comparatively feeble indications, or, as the clouds gathered to blackness, usually gave signs of a strongly negative influence. His general inference, that "*the air appears to be electrified at all times, and that its electricity is constantly positive*," was the result of frequent experiments made in the course of two years, by means of a kite with a wire extended through its string, and by an insulated electrometer of pith balls, affixed to the end of a rod, projecting from the upper part of his house at Islington. Having, however, observed a passage in Sir H. Davy's "Elements of Chemistry," in which he speaks of "clouds as being usually negative," and inclines to the conclusion, that plants are acted upon by a positive electricity in regard to the atmosphere, I took the liberty of requesting the opinion of my friend, Mr. Sturgeon, as the result of the numerous experiments which I knew he had made upon the electricity of the atmosphere, and was favoured with the following obliging and satisfactory reply:—

"In the first place, I perfectly agree with you as to the solution of the results of Sir Humphrey Davy's experiments on corn; for the positive pot of a voltaic battery would supply the animating electric fluid to the germinating seed in precisely the same manner that nature supplies it from the atmosphere to the ground. As he does not state from what 'experiments made on the atmosphere,' he draws his conclusion that 'clouds are usually negative,' I am unable to form any opinion respecting them; but I must beg permission to state, that such a conclusion is quite at variance with the result of my experiments. It is true, I have obtained negative charges at the kite-string, but the instances are very few indeed. Those which did occur were only whilst heavy clouds passed over the kite; the indications both before and after the clouds' transit being invariably positive. And even in those temporary exhibitions of negative electricity I am very far from concluding that the clouds themselves were negatively electric. The indications were those of the kite, which was floating much lower than the clouds; and the air in the vicinity of the kite was consequently the *only part* of the atmosphere explored during each experiment; which air probably became negative, or deprived of most of its natural electricity by the repulsive force of the accumulated electric matter in the positively charged clouds. This assertion can hardly be construed into 'begging the question'' or 'straining a point,' because such phenomena are easily produced by experiment, and must frequently occur in nature.

"The results which I have obtained from experiments made at nearly all the seasons of the year, and at all times of the day, and many at night, induce me to believe that the *general* electric state of the atmosphere with its contained clouds, vapours, &c., is with *reference* to the earth positive. All electrical phenomena are *relative*, and consequently all our calculations respecting them have no other object than the ever-varying degrees of those relations; but the relations themselves appear to be constant and uniform. Therefore *I conclude generally, and my conclusions are from direct experiments, that the atmosphere taken as a whole is constantly in an electro-positive state, with reference to the earth, and that in the atmosphere itself, the upper regions are constantly electro-positive, with reference to all those situated nearer to the surface of the earth.*

In corroboration of Mr. Sturgeon's statement, my friend, Mr. Weekes, informs me, that about twenty years since, though little more than a youth, and knowing but litttle of what had been done by philosophers, but being exceedingly attached to electrical experiments, he mounted a large pole on the top of a very high tree; on the top of which was fixed a large, sharp iron rod (insulated), and from it a wire communicated with a rather large but delicate electrometer, placed in an adjoining cow-shed. "I have," he observes, "turned to my manuscript notes of that period, and, with singular pleasure, I find that upwards of 90 observations made with this apparatus *during seven months, from December to July, are in perfect accordance with the experiments of our friend, Mr. Sturgeon*, as well as your own theory."

The facts, then, of the constant presence of electric fluid in the atmosphere, and of the superior conducting efficacy of the points and tubes of vegetables above that of pointed metallic rods, or any other substances in nature, are, I trust, sufficiently established; from whence the constant mutual action between them appears a necessary consequence. The tubes of plants are continually imbibing the fluid from the atmosphere, which is as constantly replenished from some other source. That that source is no other than the sun, appears

peculiarly manifest from the following experiments of the Abbé Mazeas, made in the months of June, July, and October. He erected an iron rod, 370 feet in length, on an elevation of 90 feet above the horizon. Being insulated by silken cords, sheltered from the rain, at Chateau de Maintenon, when he began his experiments on the 17th of June, the electricity of the air was sensibly felt every day, from sun-rise till seven or eight in the evening, except in moist weather, when he could perceive no signs of electricity. In the driest nights of the summer he could discover no signs of electricity in the air; but it returned in the morning when the sun began to appear above the horizon, and vanished in the evening, about half an hour after sun-set. The strongest common electricity of the atmosphere during that summer (1753) was perceived in the month of July, on a very dry day, the heavens being very clear, and the sun extremely hot. The distance of ten or twelve lines was then sufficient for the approach of light particles to the conductor, in order to see them rise in a vertical direction, like the filings of iron on the approach of a magnet; whereas, in ordinary dry weather, the wire attracted the dust at no greater distance than three or four lines.* I am unable to conceive of any facts which can more directly and evidently show that electricity, in common with light and heat, derives its origin from the sun as its source and centre; it is shown to accompany him with the same constancy as light and heat, and to exist with the greatest intensity in union with his intensest beams. Some observations made by me in the course of the last summer appear admirably to accord with this conclusion. By inverting glass jars upon the soil in the day and night seasons in generally dry weather, I observe that, when neither the light and heat of the sun, nor his heat when the light was excluded, would extract any moisture from the earth, moisture was copiously given out from it during the absence of the sun, which was again absorbed on his return. As these effects appear to be the reverse of the ordinary results of light and heat upon moist bodies, I can only account for it from the opposite electrical states of the earth and atmosphere in the presence and absence of the sun. During the continual dispersing of the solar rays in the atmosphere by day it is positively electrified with respect to the earth, the moisture of which being also negative, does not combine with the fluid in the form of vapour; but, on the contrary, absorbs it while remaining in the liquid state. As night approaches, on the other hand, large quantities of moisture having transpired from the leaves, which, together with the extraction of oxygen from them in the form of gas, occupies a large portion of the solar rays in the atmosphere, the small qnantity which is left in the soil combining with the rays which it has imbibed, they become positive in regard to the atmosphere, the superabundant solar or electric fluid combines with the residuum of water in sufficient quantities to transform it into vapour, in which form it rises to be almost immediately recondensed in dew, by the attraction of the fibrous and other acute extremities of the tender herbs.

What the reciprocal effects produced by the mutual action of the atmosphere and of plants upon each other actually are, is so beautifully shown in the experiment to which I have alluded in the *Atlas* for August 24, 1828, that I am tempted to transcribe it:—

"For the double purpose of ascertaining the power of spires in modifying the electric relation of the atmosphere and the earth, and in effecting the progress of vegetation, by their electric influence, M. Astier insulated a sextuple spire of the *gleditzia triacanthus*, at the top of his house, and brought a wire from it to an insulated flower-pot, in which were planted five grains of maize; a similar sowing was made in an uninsulated pot for the purpose of comparison. The experiment continued from the 6th to the 20th of June, including two stormy days. The electrometer gave considerable signs of electricity in the flower-pot, and by using the condenser sparks were produced. The electrified grains were found to pass more rapidly than the unelectrified grains through the first periods of vegetation. When Bengal rose-trees were submitted to the same experiment, the flowers of the electrified plant appeared more rapidly and more abundantly than in the other case."

The narration is brief, and one important particular seems not to have been determined, viz. whether the electricity was *plus* or *minus*; though, from the foregoing considerations, little doubt can be entertained that the fluid issuing from the sun had rendered the atmosphere thus strongly *positive*, in a region in which his beams are so copiously dispensed. Admitting this to have been the fact, here is a clear illustration of the principle that the atmosphere, receiving a constant supply of electric fluid from its great source in the centre of the solar system, is continually imparting of its superabundance to the vegetable kingdom through its acute extremities, and thus causes or promotes its germination and growth—while a portion of it being transmitted to the earth, that approach

* Priestley's History of Electricity, pp. 363, 364.

towards an equilibrium which is essential to the general harmony of nature is maintained.

That the electricity of the atmosphere in the night season should occasionally be negative, and that it should ordinarily be in a less degree positive than during the presence of the sun, agreeably to the experiment above related, appears to be in perfect accordance with the very different states and operations of plants by day and night respectively. The transpiration of vapour, and the yielding of oxygen gas from the leaves, are processes peculiar to the day season, and to which the action of the solar rays is essential; whereas, during the absence of the sun they appear to be occupied by the attraction of vapours and of carbonic acid. Such, at least, are the facts which have constantly been offered to my observation in the course of the last summer, by means of numerous experiments, which I may have occasion more particularly to relate hereafter. It is true this representation does not literally coincide with the statement of Mr. Cavallo, and my friend, Mr. Sturgeon, respecting the *constant* positive electricity of the atmosphere. But their observations being principally confined to the day season, and without any particular reference to the state of vegetation, must, I conceive, be considered as mainly relating to that portion of time; while experiments relating to the variations occasioned by the presence and absence of the sun, and by the different operations of plants by day and night, and at different seasons of the year, are, I apprehend, reserved in a great degree for future investigation. In the mean time, the facts of the *general* positive electricity of the atmosphere, of the extreme conducting activity of plants in imbibing this superabundance and transmitting a portion of it to the earth, while *the residue is efficacious in promoting their germination and growth*, is, I trust, in a great degree, established by what has been advanced. Many particulars will, however, transpire in the course of a more detailed inquiry, which may conduce to conform and illustrate these positions.

Should it be thought that in the above statements I have made too liberal a use of the experiments and observations of others, I can only plead that my general object, in a manner, obliged me to search for assistance from any authentic sources of information from whence it could be derived, and that thus they are brought to support principles which do not appear to have been in the contemplation of the excellent electricians to whom we are indebted for the facts; those I mean which are taken from printed documents, with the exception of M. Astier's, whose further communications are indeed most desirable. As to those of my two most ingenious and excellent friends, they being communicated for the express purpose of aiding me in the general inquiry, I could do no other than thus to bring forward the decisive evidence with which they have so generously furnished me in support of positions which must otherwise have remained in a great degree in the state of mere hypothesis.

(To be continued.)

INSECT ARCHITECTURE.

It can never be too strongly impressed upon a mind anxious for the acquisition of knowledge, that the commonest things by which we are surrounded are deserving of minute and careful attention. The most profound investigations of Philosophy are necessarily connected with the ordinary circumstances of our being, and of the world in which our every-day life is spent. With regard to our own existence, the pulsation of the heart, the act of respiration, the voluntary movement of our limbs, the condition of sleep, are among the most ordinary operations of nature; and yet how long were the wisest of men struggling with dark and bewildering speculations before they could offer anything like a satisfactory solution of these phenomena, and how far are we still from an accurate and complete knowledge of them? The science of Meteorology, which attempts to explain to us the philosophy of matters constantly before our eyes, as dew, mist, and rain, is dependent for its illustrations upon a knowledge of the most complicated facts, such as the influence of heat and electricity upon the air; and that knowledge is at present so imperfect, that even these common occurrences of the weather, which men have been observing and reasoning upon for ages, are by no means satisfactorily explained, or reduced to the precision that every science should aspire to. Yet, however difficult it may be entirely to comprehend the phenomena we daily witness, every thing in nature is full of instruction. Thus the humblest flower of the field, although, to one whose curiosity has not been excited, and whose understanding has, therefore, remained uninformed, it may appear worthless and contemptible, is valuable to the botanist, not only with regard to its place in the arrangement of this portion of the Creator's works, but as it leads his mind forward to the consideration of those beautiful provisions for the support of vegetable life, which it is the part of the physiologist to study and to admire.

This train of reasoning is peculiarly applicable to the economy of insects. They constitute every large and interesting part of the animal kingdom. They are everywhere about us. The spider weaves his curious web in our houses; the caterpillar constructs his silken cell in our gardens: the wasp that hovers over our food has a nest not far removed from us, which she has assisted to build with the nicest art; the beetle that crawls across our patch is also an ingenious and laborious mechanic, and has some curious instincts to exhibit to those who will feel an interest in watching his movements; and the moth that eats into our clothes has something to plead for our pity, for he came like us, naked into the world, and he has destroyed our garments, not in malice or wantonness, but that he may clothe himself with the same wool which we have stripped from the sheep. An observation of the habits of these little creatures is full of valuable lessons, which the abundance of the examples has no tendency to diminish. The more such observations are multiplied, the more are we led forward to the freshest and the most delightful parts of knowledge; the more do we learn to estimate rightly the extraordinary provisions and most abundant resources of a creative Providence; and the better do we appreciate our own relations with all the infinite varities of Nature, and our dependence, in common with the ephemeron that flutters its little hour in the summer sun, upon that Being in whose scheme of existence the humblest as well as the highest creature has its destined purposes. "If you speak of a stone," says St. Basil, one of the Fathers of the Church, "if you speak of a fly, a gnat, or a bee, your conversation will be a sort of demonstration of His power whose hand formed them; for the wisdom of the workman is commonly perceived in that which is of little size. He who has stretched out the heavens, and dug up the bottom of the sea, is also He who has pierced a passage through the sting of the bee for the ejection of its poison."

If it be granted that making discoveries is one of the most satisfactory of human pleasures, then we may without hesitation affirm, that the study of insects is one of the most delightful branches of natural history, for it affords peculiar facilities for its pursuit. These facilities are found in the almost inexhaustible variety which insects present to the entomological observer. As a proof of the extraordinary number of insects within a limited field of observation, Mr. Stephens informs us, that in the short space of forty days, between the middle of June and the beginning of August, he found, in the vicinity of Ripley, specimens of above two thousand four hundred species of insects, exclusive of caterpillars and grubs,—a number amounting to nearly a fourth of the insects ascertained to be indigenous. He further tells us, that among these specimens, although the ground had, in former seasons, been frequently explored, there were about one hundred species altogether new, and not before in any collection which he had inspected, including several new genera; while many insects reputed scarce were in considerable plenty*. The localities of insects are, to a certain extent, constantly changing; and thus the study of them has, in this circumstance, as well as in their manifold abundance, a source of perpetual variety. Insects, also, which are plentiful one year, frequently become scarce, or disappear altogether, the next—a fact strikingly illustrated by the uncommon abundance, in 1826 and 1827, of the seven-spot lady-bird (*Coccinella septempunctata*), in the vicinity of London, though during the two succeeding summers this insect was comparatively scarce, while the small two-spot lady-bird (*Coccinella bipunctata*) was plentiful. (*To be continued.*)

* Stephens's Illustrations, vol. i., p. 72, note.

THE

SPIRIT OF THE INDIAN PRESS,

OR

MONTHLY REGISTER OF USEFUL INVENTIONS,

AND

IMPROVEMENTS, DISCOVERIES, AND NEW FACTS IN EVERY DEPARTMENT OF SCIENCE.

ORGANIC REMAINS IN THE SEWALIK HILLS.

We observe in the Delhi Gazette that a magnificent collection of fossil bones was presented to the museum by Captain Cautley of the Bengal artillery. These organic remains come from the range of hills formerly called Sewalik, which skirt the base of the Himalayah mountains from the Ganges to the Sutlege

river, or from N. L. 30° to 31°. They abound in part of the range to the westward of the Jumna river and belong to the genera Mastodon, Elephant, Hippopotamus, Rhinoceros, Hog, Anthracotherium, Horse, Ox, Deer, Antelope, Canis, Felis, Garial, Crocodile, Emys, Trionyx, besides fish and shells. Among the fossils there were some considered to be new genera, and one which Capt. Cautley and Dr. Falconer have called Sevatherium. The monkey of a large species has been found fossil in the Sewalik Hills.

THE HIGH ROAD BETWEEN BOMBAY AND CALCUTTA.

The feasibility of this plan has been long since shown, and when the British Government in India begins to look to its own interests and those of the people, no doubt such a road will be opened. The Friend of India makes the following observations on the subject.

The advantages to be derived from laying open this country by means of a great high way, and a free communication with the more civilized districts east and west, are such as to give a strong cast of benevolence to the project. The tract of land through which this route would pass, measuring about 400 miles square, is at present one of the wildest which can be conceived. The greater part of it is overgrown with thick forests and jungles, the abode of wild beasts, while the patches of cultivation which occasionally intervene, are occupied by men little elevated above the brute. Yet the country is eminently endowed by nature with advantages. It abounds in hills, rich in ore, and in valleys capable of the highest cultivation. It requires only the progress of civilization to fill the region with smiling villages and thriving towns. The productions of these extensive countries are very imperfectly known. It is certain however that they abound generally with fine timbers. The lac and tussar silk insects afford their products plentifully throughout. The hills generally, and the eastern ones in particular, are rich in iron ores. The Palamow district possesses extensive fields of coal. The soil in Sirgoojah, it is stated by Hamilton, "is singularly rich, and so well supplied with moisture that even the tops of the hills are marshy." The valleys yield vast quantities of Tickoor (Circuma angustifolia) from which the Natives prepare a farinaceous powder scarcely to be distinguished from the arrow root of the West Indies. The district of Sumbhulpore produces abundance of rice, cotton, and iron, and also diamonds and gold dust. The high table land of Mynput, which is considered salubrious, is situated in this district. The uplands generally of these countries are represented to be well adapted for dry grains and pasturage, while the valleys yield the most abundant crops of rice. There being no outlet however from these provinces by rivers or roads, no produce is raised beyond what the inhabitants themselves require, and thus no means are afforded them of bettering their condition, by bartering their own productions for those of their neighbours. Like every other tract in a state of nature it is partially unhealthy; but after clearing the first ranges of the Burabhoom and Singhboom hills, the country expands into extensive grass plains, and reaches an altitude of between two and three thousand feet, which secures it a moderate temperature in the hot weather, and the advantage of bracing cold in the winter. By carrying a high way through this country, the first step would be taken to bring this wild waste into cultivation and to impart the blessings of civilization to its rude inhabitants.

In a commercial point of view, the construction of such a road offers the most advantageous prospects. Singular and even incredible as it may appear, it is no less true that, at present the only route for merchandize from Nagpore and its vicinity to Calcutta, is by Jubbulpore, Rewah, and Mirzapore. The direct distance between Nagpore and Calcutta is 500 miles, the route now traversed by merchandize exceeds 1000; and of this route, that portion of which lies between Nagpore and Jubbulpore can scarcely be called a road. It is certainly no small inconvenience to trade, that the valuable productions of Berar, are thus obliged to describe a circuit of a thousand miles before they reach the port of Calcutta. But were a road once opened, as we have been proposing, the produce of that kingdom would be imported directly into Calcutta, at only half the outlay of time and money which is at present indispensable, while the greatest facilities would be afforded for pouring British manufactures into the provinces in the centre of India.

In a military and political point of view, the advantage of a high road through the centre of India, from Bombay to Calcutta, are too obvious to need recapitulation, and it may be sufficient therefore to cite the opinion of that eminent statesman Sir John Malcolm, who, in his evidence before the House of Commons, says, "I have thus endeavoured to shew that the construction of a direct Highway from Calcutta to Nagpore would be productive of great and permanent advantages in a political, commercial, and military point of view,—what the advantages from the land revenue of such a country might prove when improved and settled, I shall not venture to calculate."

The same paper has the following sensible remarks on a,

ROUTE BETWEEN RAJMAHL AND CALCUTTA.

By one of the late arrivals we learn that the rail road between Utica and Schenectady in America has just been completed at an expense of about £ 310,000. The distance between the two places is about seventy-seven miles; so that the outlay has been at the rate of about 40,000 Rupees a mile. The moderation of this expense, compared with heavy charges incurred in England, in the construction of similiar works, naturally leads the mind to contemplate the possibility at no distant period of giving this country the inestimable benefit of rail roads; and as a first experiment, of connecting the Western Provinces with the Port of Calcutta by such a contrivance. We apprehend that all the iron employed in the Ohio road was imported from England, and at a rate of freight not much above that which obtains between Liverpool and Calcutta. The nature of the ground on the American line of road, must also have been similar to that of the plains of India, to account for so small an outlay; as it is well known that the greatest portion of the expense of these enterprizes in England arises from the hilly nature of the locality over which the road passes, and the charge for constructing viaducts. It may therefore, we think, be assumed, that the outlay on a road across the plains of Bengal, would not greatly exceed that which has been incurred on the present occasion in America. If this supposition approach the truth, the expence of a rail road from Rajmahl to Calcutta, the distance in a straight line being one hundred and sixty miles, would be about sixty-four lakhs of Rupees, which is not more than fourteen lakhs above the charge which the canal between Rajmahl and Culna, so long contemplated, was estimated to cost. Whenever, therefore, the funds of the State are sufficiently strong to authorize the adoption of means for facilitating this com-

munication, we think there can be little question that a rail-way will be found preferable to a canal.

Perhaps there is no part of the country, possessed of greater natural facilities for the construction of a rail road, than that to which we allude. The line is not like other parts of Bengal intersected with streams, neither does the obstruction arising from undulations of the soil exist to any extent. It lies moreover in the vicinity of the coal mines; Rajmahl would supply coal, for one portion of the route, and Burdwan for the other. The advantages of establishing such a line to the commerce of the country, and to the general intercourse of society, are incalculable. No enterprize could perhaps be thought of more useful, more necessary, or more likely to yield a profitable return than this. The distance would be traversed in a little more than five hours; so that a journey to Rajmahl and back again might be performed in a single day. Of course all the freight which is now sent up, or brought down by way of the Soonderbuns during the dry months, would be dispatched by the rail road; and the speed of the communication, the absence of risk, and the moderation of the expense, would possibly induce the transmission of all merchandize, even during the rains, by this channel. All European passengers would necessarily avail themselves of it; and the point of starting to the Western Provinces would be removed from Calcutta to Rajmahl. This place would at once become the port for our Steamers; there would no longer exist any necessity to employ a flat in addition to the steamer, and a steam vessel without this drag might easily reach Allahabad from Rajmahl in less than ten days. So vast indeed is the commerce that would instantly occupy this road, that the expenditure which Government might incur would in all probability be refunded in a few years, while the advantage of shortening the distance between the metropolis and our northwestern frontier by ten days would be found, in a political point of view, an object of the highest advantage to Government. We have thrown out these ideas, in the hope that others better able to enter into details, will be induced to discuss the plan, and thus pave the way for its eventual adoption.

GEOGRAPHY AND STATISTICS OF INDIA.

At a recent meeting of the Asiatic Society, it was determined to engraft a geographical and statistical class upon the parent stock of that institution, which will no doubt attract the attention of our leading scientific characters, and steps will be taken to encourage geographical and statistical researches at this Presidency, and to place the documents which may be collected on these subjects on record.

SUGAR CANE IN INDIA.

Our readers will perceive from our numerous extracts from the Mofussil papers, the value of the press, beyond the Mahratta ditch. The following, from our able contemporary of the *Meerut Observer*, will not, we presume, be deemed unimportant at this moment.

As the country cane is far inferior to the canes of Otaheite and Mauritius, especial care has been taken to naturalize them, and the attempt has so far succeeded that they have after nine years' cultivation not been found to degenerate in India under common care, been proved to yield four times as much as the country canes, and that hopes are entertained that in four years more the country cane will be completely displaced. That this is not a chimerical hope we beg to record a fact which, however astonishing it may appear, is vouched for in the high authority of Capt. Cautley. Two years since Colonel Colvin received from Calcutta about seven living Otaheite canes; from these he has succeeded in raising a large plantation; last year he sent nine canes to Capt Cautley, who planted them at Manuckmow, and reaped this year no less than 540 canes from them, being a sixty-fold return for the cuttings planted; nearly the whole of these Capt. C. purposes replanting with the view of distributing the produce amongst the Zumeendars of his neighbourhood. The Horticultural Society of Meerutt has received a supply of cuttings of the same cane from Dr. Stevenson at Lucknow, from Colonel Colvin's plantation at Dadoopoor, from Capt Cautley, and from Capt Sleeman's Jubbulpoor Establishment, which ought to enable the Committee to raise a sufficient quantity of cuttings for next year, to distribute amongst the neighbouring planters.

From the same paper, we extract the following

REMARKS ON THE CORN OF THE SPRING CROP, IN THE NORTHERN DIVISION OF THE DOAB, IN THE UPPER PROVINCES OF INDIA.

By Capt. Brown, Revenue Surveyor.

Considerable attention has lately been paid towards the improvement of certain products adapted for exportation. It may be thought worthy of consideration to ascertain whether produce for home consumption, particularly the more valuable sorts, may not be equally capable of improvement with great benefit.

The mass of the population of India being almost wholly employed in Agricultural pursuits, has long been considered prejudicial to the improvements of the country, the first step to which must naturally be looked for to a new system, and cannot be better commenced, than by acquiring superior produce as the first stimulant to further industry.

The Agricultural products of India, as far as regards Corn, have probably never undergone any changes. Although in Europe great advantages from time to time have been derived by the introduction of superior foreign grain, the attention of Agriculturists seems still to be drawn to the subject, and new and important acquisitions to the English farmer have lately been made in the Victoria Wheat.

The light Corn of India as at present grown may be best suited for dry light upland soils without irrigation, but the rich and irrigated soils certainly deserve a better and heavier description of grain than that now used.

In order to shew the necessity of improvement, the following is a short description, with sketches, of barley and wheat grown in India, compared with common wheat grown in England, and wheat in Syria, the latter in a climate somewhat similar to this, premising that the crops selected of Indian produce, was of the best description procurable in the district of Saharunpoor.

No 1. Barley, length of straw 3 ft. 2 inches, 54 grains in the ear, weighing 30 grains.

No. 2. Common red wheat, length of straw 3 ft. 9 inches, 38 grains in the ear, weighing 21 grains. This is the wheat sown generally in the Dooab in all soils.

No. 3. The Daoodee or Beardless wheat, length of straw 3 ft. 8 inches, 28 grains in the ear, weighing 22 grains. The District of Rewarree in Dilhi is famous for this wheat, the flour from it is used for the finest sort of bread and sweetmeat.

No. 4. Bearded large white wheat, 43 grains in each ear, weighing 31 grains. This wheat is very uncommon; it is sometimes grown in the Futtyghur District, a few heads of it were found at Saharunpoor.

No. 5. Heshbon wheat as sketched and described by Messrs. Irby and Mangles in their travels

in Nubia and Syria &c., length of straw 5 ft. 1 inch, 84 grains in the ear, weighing 193 grains.

Common English wheat length of straw 4 ft. 2 inches, 41 grains in the ear, weighing 42 grains.

COALS RAILS—ROADS.

We beg to call the attention of all concerned to the following sensible remarks which we have taken from the *Agra Ukbar*.

If the Government is too poor or disinclined to enterprise, it may awaken able, as well as monied men to the speculation. It is asserted that the expense is too great, look to North America, and our own country for what united efforts will effect. I say not, that it is imperative that the Company's Government should expend *with risk*, some little of their surplus revenue in bettering their charge, as they rent the state, at on e as a speculation, of £ s. and *d*; but when evident profit will be the result of the application of funds to *any extent* in rail roads, it seems quite out of all calculation that the means at command should be overlooked. The material for forming Iron manufacturing establishments equal to those of Merthy, Tydil, &c. in South Wales exist here, coal, iron, ore, and lime in as great profusion, as these minerals are attainable there. To erect furnaces, make rails, and lay them to Mirzapoor for coal, and all our commerce there, would soon repay the outlay. Cotton now taken away by bullocks in many weeks, would not occupy as many days in transporting by locomotive engines. and rail waggons – merchants would soon be compelled to resort to the road waggons a supply of coal for all purposes of inland, or other navigation at hand with the river Nerbudah, for ⅘ of it's course available for supplying Bombay with coal and carrying off the bulky heavy staple productions of the valley districts, and where the rocky impediments to navigation are not to be overcome, rail waggons along the side to the nearest point where boats could approach, could be employed, although I see not why from Hurdia to Panwell a rail road might not be driven. It will be asserted that the Tapty forms an insurmountable obstacle, let it be proved I suspect that many places near Boorhanpoor on that river would admit of bridging. The quality of the coal now under consideration is equal to the best English, and when at this moment no serious impediment presents on this side the Cape excepting the want of sufficient good coal, to any extent of steaming, surely the demand and sale of it and iron would render of itself so profitable a return, that commercial tolls and hire of engines would alone create a revenue more than sufficient to keep up all establishments and pay for wear and tear. In a military point of view the transport of guns. of heavy stores of bodies of men in so few hours; so many miles, must be considered. The Post Office establishment totally set aside on the whole line, it would bring Calcutta within a week's journey of Bombay. Passengers from Bengal to Bombay would never take any other route or way of travelling, supplies for the interior would be brought up for a trifle, fresh, uninjured, and secure from loss. The grand line from Bombay to Mirzapore once completed and endless ramifications would result, the country would within a very few years assume a very different aspect, cities like those of the United States would arise at places of commercial interest, others decayed would be renewed, and the bustling activity of a North American be assumed by the quietest believers in the wisdom of their fore-fathers in the world. In North America a road precedes the population; here we have no such things for our teeming subjects. That by my procuring the official reports on this subject, and publishing them in your paper, I trust I may attract the attention of some who would be willing to attempt what is no vagary untried theory, the effort of an idler's brain, but what the many hundred miles of similar roads in Europe and America have proved – Until a fit man is sent to survey the country through which the work is to proceed, no average of expense can be taken, and no comparison with English prices per mile. Let a few miles be set about, and we could form an estimate.

SAUGOR RAIL ROAD COMPANY.

We are glad to find the daily press of Calcutta acknowledging that our progress in the mechanical arts are likely to overcome all difficulties to a Saugor rail road.

We understand that, owing to circumstances with which it is not necessary to trouble the public, Mr. Hornemann, who lately came out to Calcutta in behalf of the Saugor Rail Road Company, is about to return to England. Mr. Hornemann's absence will, however, be but temporary, as he is now, we hear, perfectly satisfied of the feasibility of the project, some slight deviations from the original plan suggested by recent surveys being to be made by the Directors. The report of the officer who lately went down to ascertain the state of the navigation of Lacam's channel and Channel creek is, on the whole, very favourable to the project. The practicability of the latter is, we believe, determined to be beyond all question, and as the Saugor Rail Road Company, will, of course, adapt the situation of their road and dock to the state of the channels, the feasibility of navigating Lacam's channel becomes a matter of less present importance. We shall look with some anxiety for Mr. Hornemann's return, for there can be no doubt that, if the plan in the amended shape proposed, be practicable, it will merit the fullest support from the community of Calcutta.

As conneeted with Mr. Hornemann's skill in the matter of railway, the following particulars connected with the Greenwich Railway may not be uninteresting to our readers. 'The Greenwich Railway may be said to be a continuation of the new London Bridge to Greenwich; it is elevated on arches of brick work averaging 26 feet from the ground to the crown of each, 25 feet in breadth, with a foot path of the same dimensions. The south side is planted with various forest trees, which forms a delightful walk for the citizens of London; there is also a road on the north side, of 25 feet, which the directors have not determined as yet for what purpose they will appropriate it.

LATE INTELLIGENCE FROM EUROPE.

We have just received the *Madras Herald*, which contains the proceedings of the British Association. Such are the important discoveries—and science in the management of balloons, that we have delayed our publication in order to enable us to lay the whole before our readers in our present number.

The Examiner, September, 4, 1836.

BRITISH ASSOCIATION.

The various sections of this philosophic congress—would that such "congresses" for ever took place of such as Europe has been most familiar with—assembled on Friday, the 26th ult. We select for notice a portion of discussion in the geological section, not only as curious in itself, but as exhibiting the degree of lurking science in existence, which meetings of this kind may bring to day. After some remarks on the change in the chemical character of minerals, produced by galvanism, made by Mr. Fox, the Chairman (Mr. Murchison) said, it had been observed to them last evening, that the test of some of the highest truths which philosophy had brought to light was their simplicity. He held in his hand a blacking-pot, which Mr. Fox had bought yesterday for a penny, a little water, clay, zinc, and copper, and by these humble means he had imitated one of the most secret and wonderful processes of nature—her mode of making metallic veins. It was with peculiar satisfaction he contemplated the valuable results of this meeting of the association. There was also a gentleman now at his right hand, whose name he had never heard till yesterday, a man unconnected with any society, but possessing the true spirit of a philosopher; this gentleman had made no less than twenty-four minerals, and even crystalline quartz. (Loud cries of "Hear.") He (Dr Buckland) knew not how he had made them, but he pronounced them to be discoveries of the highest order; they were not made with a blacking pot and clay, like Mr. Fox's, but the apparatus was equally humble; a bucket of water and a brickbat had sufficed to produce the wonderful effects which he would detail to them. Mr. Cross, of Broomfield, Somerset, then came forward, and stated that he came to Bristol to be a listener only, and with no idea that he should be called upon to address a section. He was no geologist, and but little of a mineralogist; he had, however, devoted much of his time to electricity, and he had lately been occupied in improvements in the voltaic power, by which he had succeeded in keeping it in full force for twelve months by water alone, rejecting acids entirely. (Cheers.) Mr. Cross then proceeded to state, that he had obtained water from a finely crystallized cave at Holway, and by the action of the voltaic battery had succeeded in producing from that water, in the course of ten days, numerous rhomboidal crystals, resembling those of the cave; in order to ascertain if light had any influence in the process, he tried it again in a dark cellar, and produced similar crystals in six days with one-fourth of the voltaic power. He had repeated the experiments a hundred times, and always with the same result. He was fully convinced that it was possible to make even diamonds, and that at no distant period every kind of mineral would be formed by the ingenuity of man. By a variation of his experiments he had obtained gray and blue carbonate of copper, phosphate of soda, and twenty or thirty other specimens. If any members of the association would favour him with a visit at his house, they would be received with hospitality, though in a wild and savage region on the Quantock Hills, and he should be proud to repeat his experiments in their presence. Mr. Cross sat down amidst long continued cheering.—Professor Sedgwick said he had discovered in Mr. Cross a friend, who some years ago kindly conducted him over the Quantock Hills on the way to Taunton. The residence of that gentleman was not, as he had described it, in a wild and savage region, but seated amidst the sublime and beautiful in nature. At that time he was engaged in carrying on the most gigantic experiments, attaching voltaic lines to the trees of the forest, and conducting through them streams of lightning as large as the mast of a 74 gun ship, and even turning them through his house with the dexterity of an able charioteer.

Sincerely did he congratulate the section on what he had heard and witnessed that morning. The operations of electrical phenomena, instances of which had been detailed to them, proved that the whole world, even darkness itself, was steeped in everlasting light, the first born of heaven. However Mr. Cross might have hitherto concealed himself, from this time forth he must stand before the world as public property.—Professor Philips said, the wonderful discoveries of Mr. Cross and Mr. Fox would open a field of science in which ages might be employed in exploring and imitating the phenomena of nature.

On Saturday, the 27th ult. the attention of the scientific persons assembled at Bristol was invited to the laying of the first stone of the Clifton suspension bridge. The Marquis of Northampton, officiating as President of the Association, in the absence of the Marquis of Lansdowne, laid the stone with the usual ceremonies. A great concourse of spectators attended, and it is said the beautiful rocks and town of Clifton never presented so animated and interesting an appearance. The following were given as the dimensions of the bridge:—Distance between the two points of suspension, 700 feet; length of suspended roadway, 630; height of roadway above high-water mark, 230; total width of floor, 34. The architect is Mr. Brunel. In the evening, the last meeting for the transaction of the general business of the Association was held in the theatre at Bristol, when the thanks of the Association were voted to divers public bodies in that city for marks of attention respectively paid to it.—The Rev. Vernon Harcourt read a list of the various invitations that had been sent from different places to solicit the attend-

ance of the Association at its next period of meeting, which were given according to the number of applications that had been made. These were from Newcastle-upon-Tyne, four; Liverpool and Birmingham, two; Manchester, one; Worcester, one; and Leeds, one. A considerable discussion ensued, and it was at length decided that the next meeting should be held at Liverpool, in the month of September, 1837. The Earl of Burlington was appointed president; Sir P. G. Egerton, Baronet, Dr. Dalton and the Rev. E. Stanley, vice-presidents; the Rev. James Yates and Dr. Turner, secretaries; and A. J. Murchison, Esq., general secretary, in the room of Mr. Daly, who had resigned.

SCIENCE IN A BALLOON.

Dr. Kent's Account of his Ascent with Mr. W. Green from Vauxhall-Gardens, on Tuesday, August 30, 1836.

Every arrangement having been completed for launching the balloons, the signal was given at five minutes past six o'clock, p. m, and they immediately rose, the wind blowing gently from S. W. The atmosphere being remarkably clear, every object beneath us was seen with the greatest distinctness. We crossed the river a little to the eastward of London bridge, and the view at that period was most magnificent; St. Paul's seen a little to westward; the Monument nearer to us in the same direction; the Tower almost immediately below us, the London Docks, the shipping, the extended view of the river, and the beautiful and highly-cultivated country all around the metropolis, forming a *coup d'œil* of the most sublime grandeur, which sets at defiance every attempt at description. We crossed the river Lea a little to the northward of Stratford, at which time we had attained our greatest altitude, and entered a different current, which took us a little more to the eastward. We then passed over Epping Lower Forest and Wanstead Park, descending very gradually until we again reached *terra firma* at seven minutes past seven, in a beautiful grass field, close to the Maypole, on the border of Hainault Forest, four miles N. E. of Ilford. Mr. C. Green having got into a different current, we soon parted company, but we had an exceedingly interesting view of his balloon until within a few minutes of his descent. This took place at Romford; our chaises, however, met at Ilford, and we arrived together at the Gardens, Vauxhall, at eleven o'clock, p. m. It is but justice to Mr. W. Green to state, that his management of the balloon was most skilful, and that the descent was accomplished in the most easy and delightful manner. The greatest depression of the mercury in a barometer was 24.75 inches, which was its register at 6 h. 33 m., its height on leaving the ground having been ascertained to be exactly 30 inches. The thermometer, which stood at 63 deg. Fahrenheit, or 17 deg. Centigrade, on leaving, sunk to 51 deg. Fahrenheit, or 10.4 Centigrade, at which point it stood at the abovementioned time. There was consequently a depression of 5.25 inches in the height of the mercury of the barometer, and of 12 deg. Fahrenheit in the thermometer, indicating the greatest elevation to have been about 5,863 feet, or 1 mile and 580 feet. A much greater altitude could have been attained, but it was thought desirable to make the descent before it became so dark as to render it probable we might be delayed in the emptying and packing the balloon.

The management of the machine in the hands of an aeronaut so practised and intelligent as Mr. W. Green appears to be extremely simple. After leaving the earth his attention is first directed to the state of the distension of the balloon, more particularly if the sun's rays are falling on it. Two causes are then in operation which produce the effect of rarefaction and consequent expansion of the gas in the balloon; one, the diminished atmospheric pressure, and the other, the caloric imparted by the rays of the sun. Should these causes act powerfully, it becomes necessary to allow the escape of a small volume of gas from the safety-valve. Here the judgment of the aeronaut is called into exercise, as he must allow a sufficient quantity of gas to escape, to prevent any undue distension at the same time that it is necessary for him to bear in mind that he will have again to return into the same dense atmosphere he has left, when the balloon will, of course, contract into a smaller space than it previously occupied. As long as the machine continues to rise, or is sailing along at the same altitude (which is ascertained by the barometer, or by the less scientific but readier method of throwing out small pieces of tissue paper and observing the direction they appear to take), the above is the only point which requires his attention. When it is determined to commence the descent, either a small quantity of gas is again allowed to escape, or (if the balloon has already a tendency to descend) ballast is no longer thrown out, excepting as much as is sufficient to counteract in some measure the condensation of the gas by the increasing density of the atmosphere. Having descended to within 100 or 150 yards of the earth, an eligible spot for landing is selected, and the balloon is then allowed to descend again until the grappling-iron brings it to anchor, or the cord is secured by some of the persons attached to the spot. It is then drawn down gently by them, and as soon as the car rests on the ground, the valve is opened wide, the balloon is quickly emptied, and the whole being packed within, the car is reconveyed to the spot from which a few hours before it arose. The safety-valve is situated at the top of the balloon, and is about eighteen inches in diameter. It is divided into two equal parts, each of which is kept closed by the action of powerful springs. Cords are fastened to either of these valves, which pass through the centre into the neck of the balloon, within reach of the individuals in the car. The valves are prevented from being opened too far by small pieces of twine fastened to them and to the edge of the aperture. When the ground is reached, and the machine secured, these are broken by a sudden jerk of the cords, the gas escapes rapidly, and the balloon collapses.

Owing to the excellent management of Mr. W. Green, the balloon has not received even a scratch by which it is damaged.

BENJAMIN ARCHER KENT, M. D.

20, Harley-street, Cavendish square.

Plate IV

Fig. 1

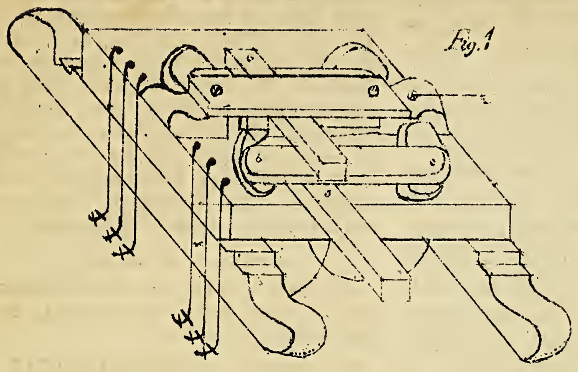


Fig. 3

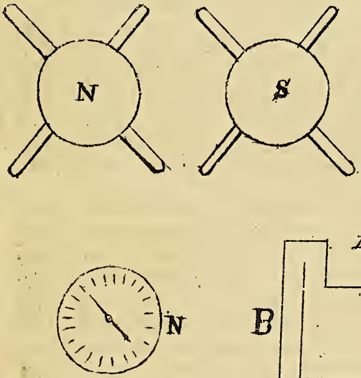


Fig. 2

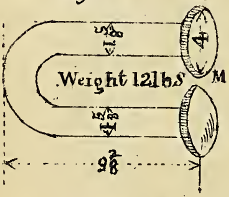


Fig. 4

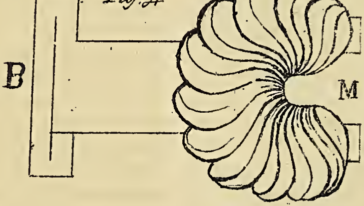


Fig. 5

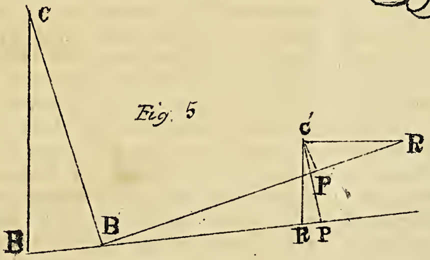
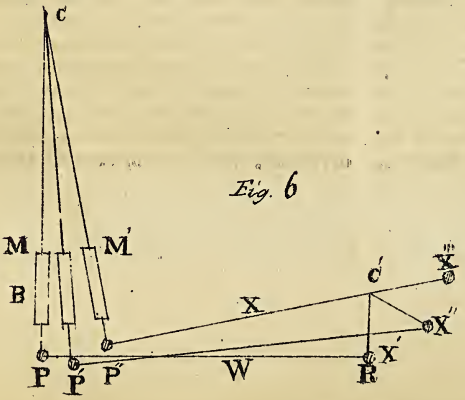
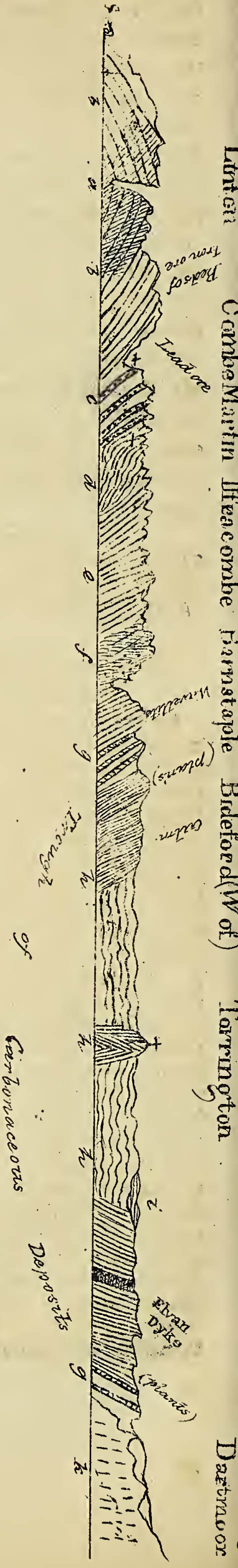


Fig. 6





Our kind friend and contemporary of the *Oriental Observer*, Mr. Rushton, has been so fortunate as to receive the latest number of the *Athenæum*; the entire columns of which have been devoted to the report of the proceedings of the British association. No expense has been spared to make it full and satisfactory. We shall continue to furnish our readers with the result of the evening meeting so that it shall not interfere with the regular number of our *Review*. We are sure that our readers will share in our sense of obligation to Mr. Rushton for this spirit and zeal he has evinced in the cause of science by enabling us to diffuse expeditiously this important and highly interesting intelligence.

SIXTH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

[*From our own Correspondents.*]

SATURDAY' AUG. 20.

At the Meeting of the General Committee, a letter was read from the Marquis of Lansdowne, stating his regret at being unable to take the chair, in consequence of the alarming illness of his eldest son (the Earl of Kerry), though all his arrangements were completed for leaving London on that evening. It was then proposed that the Marquis of Northampton should be appointed Vice-President, in the room of J. Harford, Esq., who had resigned from ill health. The motion was unanimously adopted, and an express despatched to secure his Lordship's attendance on Monday evening. Some temporary arrangements were made, to facilitate the distribution of tickets, and it was agreed that the officers intrusted with this duty should be at their posts at eight o'clock on Monday morning. Sectional officers and committees were appointed, after which the General Committee adjourned to twelve o'clock on Saturday, 27th August. To prevent the final meeting of the Association from interfering with the deliberations of the Commitee as in Dublin, it was resolved, that the close of the meeting should take place on Saturday evening, in the Theatre. It was gratifying to observe, that all traces of the temporary estrangement of Sir David Brewster from his old colleagues in the Council had disappeared. The members seemed eager to welcome him, and he was equally eager to show that past differences were forgotten. The Marquis of Northampton arrived in course of the evening.

MONDAY, AUG. 22.

At eleven o'clock, the several Sections met at their appointed stations, and proceeded to business.

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE.

President—Rev. W. Whewell.

Vice Presidents—Sir D. Brewster, Sir W. R. Hamilton.

Secretaries—Professor Forbes. W. S. Harris, Esq. F. W. Jerrard, Esq.

Committee—C. Babbage, Esq., F. R. S , F. Baily, Esq , Professor James Challis, Mr. Chatfield, Professor McCullagh, Robert W. Fox, Esq., William Frend, Esq., G. Gerard, Esq , Professor Lloyd, J. W Lubbock, Esq Rev. Dr. Lloyd, Provost of Trinity College, Professor Moll, Rev. G. Peacock, Professor Rigaud, Professor Ritchie, John Robison, Esq , Professor Stevelly, H. F. Talbot, Esq., Professor Wheatstone.

The President of the Section took the chair.—The Chairman stated that according to the directions of the General Committee, that Committee of the Section had met in the morning, and set down the papers which they deemed proper to have brought before the Section on this day; giving, as usual, a preference to those subjects which had been undertaken at the suggestion or request of the Association. It was well known, he observed, that grants of money had been voted by the General Committee in aid of important researches, and some valuable discoveries had resulted; and that on that day they were about to be gratified as well as instructed, by hearing of laborious and searching observations and experiments which, but for the valuable pecuniary aid afforded by the British Association, must have lain, as they had already done, for years, a mass of useless lumber. He concluded by stating that the Committee, in accordance with powers vested in them by the General Committee, had added to their number, the names of many highly-distinguished individuals, who had not arrived in town

at the time when the list of the Committee was printed.

The President then called upon Sir David Brewster to an account of a lens of rock salt, upon the construction of which he had been authorized by the Association assembled at Edinburgh to expend a sum of 80*l*.; as certain optical researches upon the nature and qualities of that substance, had induced men well skilled in the subject to anticipate the most favourable results to astronomy from its construction.

Sir David Brewster stated, that through the kindness and activity of Dr. Traill, he had procured from Cheshire several splendidly transparent and homogeneous crystals of rock salt; and that he had little doubt that these would in every way answer the desired end; but that, as a lens, when constructed of this material, would require to be adapted to a certain glass lens or lenses,—and as the construction of each of these and their mutual adaptation was a matter requiring not only the nicest mechanical manipulation, but also a skill and knowledge of principles which was not to be expected in workmen of an ordinary class, —he had most reluctantly been compelled to abstain from an attempt at the actual construction, but he hoped very soon to have it in his power to accomplish this most desirable object.

The President requested Mr. Baily to inform the Section, what steps had been taken towards procuring from the French observatories, the reduction of the Observations respecting certain fixed stars, for which a grant of money had been already made by the Association.

Mr. Baily replied, that as he was in daily expectation of receiving from M. Arago information respecting these reductions, which would be more precise and interesting than any thing he was at present prepared to say respecting them, he trusted the Section would permit him to defer his notice of them to a future occasion.

To this request, the President, in the name of the Section, assented, and called upon Mr. Lubbock to give an account of the recent discussions of tide observations made at the ports of Liverpool and London, and for which a liberal grant of money had also been made by the Association.

Mr. Lubbock rose and stated, that through the indefatigable exertions of Mr. Dessiou, considerable progress had been made in the reductions of the observations made at Liverpool by Mr. Hutchinson.

The diurnal inequality or difference between the superior and inferior tide of the same day, which in the Thames was very inconsiderable, if not insensible, was found at Liverpool to amount to more than a foot; a matter upon which the learned gentleman laid considerable stress, as calculated to lead to important practical results. The object of these reductions was to compare the results of theory with these observations, and with those of Mr. Jones and Mr. Russell made at the port of London. The principal objects of comparison were the heights of the several tides, and the intervals between tide and tide; and these were examined in their relations to the parallax and declination of the Moon and of the Sun, and in reference to local, and what may in one sense be called accidental causes, as storms, &c. Of this latter, one of the most curious, as well as important, is the effect of the pressure of the atmospheric column. The learned gentleman stated, that M. Daussy had ascertained, that at the harbour of Brest a variation of the height of high water was found to take place, which was inversely as the rise or fall of the barometer, and that a fall of the barometer of 0.622 parts of an inch, was found to cause an increase of the height of the tide, equal to 8.78 inches in that port. To confirm this interesting and hitherto unsuspected cause of variation, had been one principal object of the researches of the learned gentleman, and at his request, Mr. Dessiou had calculated the heights and times of high water at Liverpool for the year 1784, and compared them with the heights of the barometer, as recorded by Mr. Hutchinson for the same year; and by a most careful induction, it had turned out that the height of the tide had been on an average increased by one inch for each tenth of an inch that the barometer fell, *cæteris paribus*; but the time was found not to be much, if at all, affected. Mr. Lubbock then proceeded to examine the semi-menstrual declination and

parallax correction; and stated that the result was a remarkable conformity between the results of Bernouilli's theory, and the results of observations continued for nineteen years at the London Docks. But to render the accordance as exact as it was found to be capable of being it was necessary to compare the time of the tide, not with that transit of the Moon which immediately preceded it, but with that which took place about five lunar half days. To explain this popularly, the learned gentleman stated, that however paradoxical it might appear to persons not acquainted with the subject, yet true it was, that although the tide depended essentially upon the Moon, yet, any particular tide, as it reaches London, would not be in any way sensibly affected, were the Moon at that instant, or even at its last transit, to have been annihilated; for it was the Moon as it existed fifty or sixty hours before, which caused the disturbance of the ocean, which ultimately, resulted in that tide reaching the port of London. The learned gentleman then exhibited several diagrams, in which the variations of the heights of the tide, as resulting from calculations founded upon the theory, were compared with the results of observations. The general forms of the two curves which represented these two results, corresponded very remarkably; but the curve corresponding to the actual observations, appeared the more angular or broken in its form, for which the learned gentleman satisfactorily accounted, by stating that the observations were neither sufficiently numerous, nor sufficiently precise, from the very manner in which they were taken and accorded, to warrant an expectation of a closer conformity, or a more regular curvature. When it is recollected that the observations are at first written on a slate, and then transferred to the written register, by men otherwise much employed, and whose rank in life was not such as would lead us to expect scrupulous care, it was not to be wondered at, if occasionally an error of transcript should occur, or even if the observation of one transit was set down as belonging to the next. When to these circumstances it was added, that the tide at London was in all probability, if not certainly, made up of two tides, one having already come round the British Islands, meeting the other as it came up the British Channel, it was altogether surprising that the coincidence should be so exact; and it was one among many other valuable results of these investigations, that it was now pretty certain that tide tables constructed for the port of London, by the theory of Bernouilli, would give the height and interval with a precision quite sufficient for all practical purposes, and which might be relied on as sufficiently exact, when due caution was used in their construction, and the necessary and known corrections applied. In conclusion, Mr. Lubbock said, the Observations for the port of London had now been continued from the commencement of this century, and those for Liverpool, as we understood, about twenty-five years.

The arrangement of the papers made by the Committee now required the President to give a report of the proceedings of the Committee appointed by the Association to fix the relative level of land and sea; the chair was therefore taken by Sir David Brewster, one of the Vice Presidents, and Mr. Whewell presented himself to the Section.

He commenced by saying, that as in the discussion of the relative level of land and sea, the tides of the ocean were an important element, he should preface the remarks upon that subject, which he intended to submit, by making a few observations upon the very valuable communication of his friend Mr. Lubbock. The communication he highly eulogized, and pointed out to the Section the importance, of many of the conclusions, should they prove hereafter to be generally applicable: but he expressed strongly his fears that this would not be the case. Observation had, in the instance of the tides, far outstripped theory, for many reasons, which it would be imposible to detail; but among the most prominent were the complexity of the problem itself involving the astronomical theories both of the Sun and Moon the masses of these bodies; the motions of disturbed fluids, and local causes, tending to alter or modify the general geographical effect of the great tidewave at any particular place. It was upon a careful review of these considerations, that he was led to fear that it would be still many years before theory would be-

come so guarded and supported by local observations, as to afford a sufficiently correct guide to be implicitly relied on in these speculations. He instanced the tides of the Bristol Channel, which, in consequence of their excessive magnitude, afforded magnified representations of the phenomena by which the deviations become more remarkable. At the port of Bristol, the tide rose to a height of fifty feet, while towards the lower part of the Channel they only rose twenty, and along other parts of the coast not quite so high. The most striking of Mr. Lubbock's conclusions was that by which it appeared that the ocean assumed the form of the spheroid of equilibrium, according to the theory of Bernouilli, but at five transits of the Moon preceding the tide itself. By the calculations of Mr. Bent, however, it would appear, that although the observed laws of the tides at Bristol might be made to agree with Bernouilli's theory of equilibrium tides, by referring them to a certain anterior transit,—so far as the changes due to parallax were concerned, as also as far as those due to declination were concerned,—yet it turned out that this anterior period itself was not the same for parrallax as for declination. The two series of changes have not therefore a common origin or a common epoch; so that in fact there is no anterior period which would give theoretical tides agreeing with observed tides; and, therefore, at least the Bristol tides do not at present appear to confirm the result obtained by Mr. Lubbock from the London tides. The learned gentleman then illustrated these views by diagrams, by the aid of which he explained to the Section the luni-tidal intervals, and the curve of semi-menstrual inequality—(this latter term, and the doctrine connected with it, was introduced into the subject of the tides by the learned gentleman himself, and, as is admitted by all acquainted with the subject, with the most valuable result).

Professor Whewell then proceeded to the question more immediately before him—the proceedings of the Committee appointed to fix the relative level of the land and sea, with a view to ascertain its permanence, or the contrary. He observed, that the Committee had not taken any active practical steps for the important purposes for which they were appointed, because they had met with many unexpected difficulties requiring much consideration. It was, however, intended to appoint a Committee for the same purposes, who should be furnished with instructions founded upon the views at which the former Committee had by their labours and experience arrived. One method proposed was, that marks should be made along various parts of the coast, which marks should be referred to the level of the sea; but here the inquiry met us in the very outset—what is the proper and precise notion to be attached to the phrase the *level of the sea?* Was it high water-mark or low water-mark? Was it at the level of the mean tide, which recent researches seemed to establish? In hydrographical subjects the level of the sea was taken from low water, and this, although in many respects inconvenient, could not yet be dispensed with, for many reasons, one of which he might glance at—that by its adoption, shoals, which were dry at low water, were capable of being represented upon the maps as well as the land. The second method proposed appeared to the learned Professor to be the one from which the most important and conclusive results were to be expected. It consisted in accurately levelling, by land survey, lines in various directions, and by permanently fixing, in various places, numerous marks of similar levels at the time; by the aid of these marks, at future periods, it could be ascertained whether or not the levels, in particular places, had or had not changed, and thus the question would be settled whether or not the land in particular localities was rising or falling. Still further, by running on those lines, which would have some resemblance to the isothermal lines of Humboldt, as far as the sea coast, and marking their extremities along the coast, a solution would at length be obtained to that most important practical question,—what is the proper or permanent level of the sea at a given place? Until something like this were accomplished, the learned Professor expressed his strong conviction of the hopelessness of expecting any thing like accuracy in many important and even practical cases. As an example, he supposed the ques-

tion to be the altitude of Dunbury Hill referred to the level of the sea: if that level of the sea were taken at Bristol, where the tide rises, as before stated, fifty feet, the level of low water would differ from the same level on the sea coast at Devonshire, where the sea rises say eighteen feet; and supposing, as is most probable, the place of mean tide to be the true permanent level by no less a quantity than sixteen feet, which would therefore make that hill to appear sixteen feet higher, upon a hydrographical map constructed by a person taking his level from the coast of Devonshire, than it would appear upon the map of an engineer taking his level at Bristol. In the method proposed, the lines of equal level would run, suppose from Bristol to Ilfrocom in one direction, and from Bristol to Lyme Regis in the other, and by these a common standard of level would soon be obtained for the entire coast.

Professor Sir William Hamilton rose to express the sincere pleasure he felt at the masterly expositions of Mr. Lubbock and professor Whewell. One conclusion to which Mr. Lubbock had arrived was to him peculiarly interesting, viz. that by which it appeared that the influence of the Moon upon the tides was not manifested in its effects until some time after it had been exerted, for a similar observation had recently been made by Professor Hanxeen respecting the mutual disturbances of the planets—Mr. Lubbock rose to say, that the agreement between the results calculated from the theory of Bernouilli and those obtained from actual observation, were much more exact than Professor Whewell seemed to imagine; in truth, so close was the agreement, that they might be said absolutely to agree, since the difference was less than the errors that might be expected to occur in making and recording the observations themselves.—Mr. Whewell explained that he wished to confine his observations to the Bristol tides, as these were the observations to which he had particularly turned his attention; and, with respect to which, he should be able, at the present meeting, to exhibit diagrams to the Section, which he felt confident would amply bear out his assertions respecting these tides.—Mr. Lubbock stated, that so near, indeed so exact, had been the coincidence between the observations made at London and Liverpool, and the theory, that he was strongly inclined to believe that, that coincidence would be found at length to be universal.—Professor Stevelly inquired, from Mr. Lubbock, whether he did not think it quite possible that local causes might exist, which would be fully capable of producing the deviations from the theory of Bernouilli; as, for instance, in the case of Bristol, so ably insisted upon by Professor Whewell, where the causes of the extraordinary elevation are the landlocking of the tide-wave as it ascends the narrowing channel, and the reflexions of other tide-waves from several places. Now, particularly in the case of reflex tides, may it not so happen, and does it not, in fact, happen in several places, that they bring the actual tide to a given port at a time very different from that at which the influence of the Moon and Sun, if unimpeded, would cause it to arrive, and thus separate, as Professor Whewell had stated, the origin or epoch of the variations due, suppose to parallax and declension, and even cause other divisions from Bernouilli's theory?—Mr. Lubbock replied, that unquestionably it might so happen; but, in his opinion, the discussion of a few observations, like those made at Bristol, could not be expected to point out very exactly the origin or epoch of either of the variations of parallax or declination, with sufficient exactness, to furnish secure data for determining that they did not correspond to any one common previous transit of the Moon.

Professor Whewell, who had left the room for a few moments, now returned with some diagrams, which tended to illustrate his view of the question; and, in particular, he drew the attention of the Section to the circumstance, that the diurnal inequality, which was now beginning to be observed, decided the question, inasmuch as its epoch could not by any means be attributed to the same previous transit of the Moon to which the others were referred.—Mr. Frend congratulated the meeting upon the prospect now held out of determining precisely that most important practical question, the true level of the sea.

The President then called on Mr. Lubbock for his communication res-

pecting the formation of an empirical lunar theory.

Mr Lubbock made some preliminary remarks, tending to prove, that although the astronomical tables connected with the lunar theory are sufficiently perfect for the more general purposes of navigation, yet astronomers are by no means satisfied with resting at this degree of exactness. It is an object much to be desired that they should reach, by calculation and theory, a degree of accuracy far beyond this, and if possible construct lunar tables in which the fixed co-efficients should be as exact as could be obtained from the use of the very best instruments, erected in fixed observatories. His object was to press the accomplishing of this by obtaining directly from observation the co-efficients and other quantities which would be necessary for the construction of tables, with as little reference to previous lunar theories as was practicable or proper. He observed, that the most important works upon the lunar theory were those of Messrs. Damoiseau and Plana. The calculations of M. Damoiseau, however, are in such a very intricate form, that it is almost impossible to verify them. The work of M. Plana constitutes an entirely new era in the lunar theory, for in it the results are developed according to the powers of extentricities, inclination, and other elements of the lunar and terrestrial orbits, as also the quantity M. denoting the ratio of the Sun's mean motion to that of the Moon. In other respects, the calculations are similar to those of Damoiseau; and in both there finally meets us the almost insuperable difficulty, that the expressions for the co-efficients are series, having a very slow conveyance, and requiring, therefore, extreme labour to deduce them with any tolerable degree of accuracy. Now, it is principally these co-efficients that Mr. Lubbock wished to have the values of deduce empirically from the best observations; and he even ventured to express a hope, that by this method tables might be constructed of such minute exactness, as might serve to check the results obtained from theory; and his anticipations were the more sanguine, because nothing was wanting to complete success but the placing of a sufficient fund at the disposal of a committee, since abundant stores of the most minutely exact observations were recorded; and persons in every way competent to their reduction were to be had.

Professor Sir William Hamilton then read his report on Mr. George B. Jerrard's mathematical researches, connected with the general solution of algebraic equations.

Sir W. Hamilton wished, in the first place, to inform the Section, that no part of the grant 80*l*. had been expended, which the Association had so liberally placed at his disposal for the purpose of procuring the assistance of persons competent to verify, by numerical computations, the method of Mr. Jerrard. The reason that he had not deemed it necessary to resort to this expense was, that he had, at a very early period after the meeting of the British Association in Dublin, satisfied his own mind that the method of Mr. Jerrard entirely failed in accomplishing the solution of equations of the fifth and sixth degree; and he trusted that he should be able to lay before the Section, with as much clearness as the abstruse nature of the subject would admit of, the principal steps of a demonstration, which, to the mind of the learned Professor himself, at least carried complete conviction, that the method of Mr. Jerrard was not applicable until the equation, as a minor limit, had reached the seventh degree. In order that he might carry the Section fully along with him, Professor Hamilton stated, that it would be necessary to give again a rather detailed account of the peculiarities of the very ingenious notation, devised by Mr. Jerrard, for denoting certain algebraic processes, or operations resorted to in the application of his method. The Professor then proceeded to detail to the Section the several steps of Mr. Jerrard's method, clearly marking the steps previously known to analysts, and such as Mr. Jerrard had the merit of originating. The principal peculiarity of *formulæ* seemed to be, that in an equation, transferred in a particular manner for the purpose of eliminating the co-efficients of the original equation, the co-efficients were so ingeniously obtained as to be entirely independent of the degree of the original equation, and therefore to be of a similar form in all possible equations, the solutions of which were sought. As soon as he had prepared these formulæ, the Professor proceeded to demonstrate to the Section,

that from the very nature of their connexion with the original equation, they must fail in giving its solution, where it only rose to the fourth dimension, because he showed that this would involve the solution of an equation of the sixth degree, as a preliminary step. Equations, however, of this degree had been long solved, and it was only, therefore, in connexion with the generality of Mr. Jerrard's method, that its failure, as regarded them, was of any consequence. He then proceeded to give a similar demonstration of its failure, as regarded equations of the fifth and of the sixth degree; during his discussion of this step of his demonstration, he took occasion to show, that Mr. Jerrard's method had succeeded in reducing equations of the fifth degree to tables of double entry,—a discovery, upon the value of which he enlarged considerably, and highly eulogized and complimented the author; insomuch, that he stated that if the method had accomplished nothing but this alone, Mr. Jerrard would have received the congratulations of the scientific world. He then proceeded to show, that unless the index of the equation reached as a minor limit the number seven at least, a certain intermediate equation, concerned in the elimination, would be met with, along with a multiple of it, which, therefore, would not give a number of distinct results sufficient to complete the uliminations; but, beyond that degree, he stated that he had satisfied himself, that Mr. Jerrard's method would afford solutions of equations, which, even if they should, from their complexity or other causes, be useless to the practical or merely arithmetical algebraist, yet to those engaged in prosecuting inquiries involving purely symbolic algebra, he felt confident they would afford facilities and general methods of investigation, hitherto almost unlooked for and unexpected.

Mr. Babbage complemented Sir W. Hamilton upon the very lucid exposition which he had given of a subject which he characterized as bordering upon the very extremest limits of human knowledge, and congratulated Mr. Jerrard upon the success with which he had contrived so effectually to distinguish between the symbols of operation and those of quantity, in expressing the results of elimination. Engaged, as it was well known he was, in a branch of practical numerical science, he could not suffer himself to be supposed to look with indifference upon a discovery which, if it should even fail in affording any practically important assistance to his particular branch, must yet be admitted to afford the strongest promise of advantage to the more purely abstract branch of algebraic investigation.—Professor Peacock observed that during the progress of the discussion of this question he had not failed to remark the many advantages which must result to algebra from Mr. Jerrard's method, from the collateral improvements to which the prosecution of his principal object had led, partly in suggusting new and hitherto unexplored methods of elimination, and partly by leading to a notation, which so clearly distinguished between the marks of quantity and the observations and changes which were to be resorted to in reference to them; but as to the result itself, he need characterize it no higher, when he added, that it was an advance in the science, which it did not appear that the celebrated La Grange had ever contempleted, and which was not approached by the result of Stchernhausen.—Mr. Frend regretted to differ from Mr. Babbage; but to him it appeared that this subject, instead of ranging on the very outside verge of human knowledge, on the contrary, lay at the very entrance of its portals.

Professor Phillips then read his Report of the Experiments instituted with a view to determine the Inferior Temperature of the Earth.

Mr. Phillips stated, that this subject had for a long period engaged the anxious attention for scientific men, both at home and upon the continent; that the most accurate as well as numerous experiments indicated a decided elevation of temperature as a more depressed station below the earth's surface was attained; even when the depths descended to were small, this elevation of temperature became large enough to arrest attention; in fact, the temperature of the air, of the water, of the rocks, and of the soil, was found to augment as we descend. But, in order to ascertain if possible, what portion of this heat arose from, or was connected with, an elevated temperature of the internal parts of the globe, as well as to ascertain whether the causes of these were local or universal, and, if possible, to arrive

at the law of its distribution, it was deemed a matter of much importance to get rid altogether of the effect of the air's temperature upon the thermometer, as also the action of water, because the sources of the water in mines, &c. must be in most cases entirely beyond the reach of observation. All these circumstances induced the Committee appointed by the Association to conduct experiments upon this subject, to take the temperatures of the rocks themselves alone, as the fundamental experiments. With this view, they had no less than thirty-six thermometers made and carefully compared; and, although they well knew that these thermometers, after all the care which had been bestowed upon their construction, were by no means perfect or exact, yet as their errors had been carefully quoted, by a comparison with the standard thermometers of the Royal Societies of London and Edinburgh, and each thermometer numbered, the errors admit of an easy correction. Many of these thermometers had been already placed under the care of persons adequately instructed to conduct the requisite experiments, and some of them were still in the possession of the Committee, who would gladly place them in the charge of any person, giving adequate security that they should be applied to the purpose for which they had been procured. The method of using them was this; a hole large enough to receive one of the thermometers, is first drilled into the solid rock, at the bottom of the mine, pit, or other proper place of observation, to the depth of two or three feet at least; into this the thermometer is then introduced and suffered there to remain for a number of days sufficient to ensure the attainment of the temperature of the rock itself. The temperature of the air at the mouth of the pit,* and if possible, the mean temperature of the place, must be observed or obtained. Professor Phillips then stated, that observations had been made in this manner, and with some of these instruments, under the directions of Professor Forbes, at mines in the Lead Hills, in Scotland, and that Professor Forbes would take some early opportunity of bringing these observations more immediately under the notice of the Section; at Newcastle, under the direction of Mr. Briddle; at Wearmouth, under the care of Mr. Anderson; near Manchester, and at Northampton, under the direction of Mr. Hodgkinson: and within a few days, Professor Phillips had been enabled, through the kindness of a friend, to place a thermometer in a deep coal mine at Bedminster, in this immediate vicinity (Bristol). The results of these observations, so far as they had as yet proceeded, amply confirmed the fact of the increase of temperature in the parts under the earth's surface. As one example, the Professor stated, that in a mine, the perpendicular depth of which, below the surface, was 525 yards, the thermometer in the rock stood at 73°, while the temperature in the open air at the mouth of the mine, varied from 300 to 800, the mean temperature of the place being 47½°.

Professor Forbes then gave, from memory, an account of the experiments which he had been the means of instituting in the Lead Hills. Before he did so, however, he wished to state that he had been informed that an artesian well had lately been met with in granite; and he then gave a general description of artesian wells. It was to this effect: that heretofore, in making borings in certain districts through certain alternations of clays, and at length through certain rocks, a supply of water was reached, which rapidly rose through the boring to the surface, and continued to overflow at the top, sometimes, as the term fountain indicated, in considerable quantity, and with considerable force. He instanced the artesian wells or fountains of the London clay districts; and added that the temperature of these waters was found universally to increase with the depth of their source beneath the surface of the earth. Heretofore, no such well had been obtained by boring through the granite; and if the account, which he had received, were correct, and of its correctness he entertained little doubt, this would be a matter of considerable interest as well to the geologist as to those who were engaged in scientific pursuits similar to those now under consideration. The observations made under his directions in the Lead

* It appears to us that it would be most desirable that the temperature of the air at the bottom of the pit, and as close as possible to the rock in which the thermometer is placed, should be noted, for unquestionably this are cannot be excluded from the hole in which the thermometer is placed, and must have an elevated temperature.

Hills, alluded to by Professor Phillips, were almost entirely conducted by Mr. Irvine. These observations were particularly interesting, from the fact, that the mines, in consequence of a strike among the workmen, had not been worked for many months, and at the same time it most fortunately happened that they were selfdrained, that is, by machinery worked by external power, without the aid of either animals or steam. This most fortunate concurrence of favourable circumstances, which could be expected to be met with in so very few instances, at once disembarrassed the observations from many sources of error, which, but for this, would have still left considerable doubts of the results being, partially, at least, affected by the heat generated by animals residing and working in the mines, as well as artificial fires kept up for the purposes of ventilation or of originating power. It was upon these grounds that he perceived the importance of them, but had it not been for the valuable assistance afforded him by Mr. Irvine, who descended into the mine, and placed the thermometer and made the observations, he could scarcely have been as successful as the results already obtained warranted him in hoping he should be. These results, which, of course, had not as yet reached the degree of accuracy which he still looked for, lead to the conclusion that the temperature in that mine increased about 50 of Fahrenheit for a descent of ninety-five fathoms. —Professor Stevelly stated, that as practical utility was one of the principal objects of the British Association, he might be permitted to add, that the waters of these wells, in consequence of their temperature being in general elevated above the mean temperature of the place at which they delivered their waters, had been applied to the very important practical purpose of freeing machinery of ice in winter, insomuch, that by their instrumentality, machinery, such as water-wheels, &c., which had always previously been clogged by ice for a considerable part of the winter, to the great loss of the owner's manufactory, were, by the aid of the waters of these fountains, kept constantly free, while the same water had even been previously, in some instances, conducted through the factory itself, with a view to keep up a uniform and elevated temperature within its walls, thus affording a second and a very valuable practical application.

The Rev. Mr. Craig now read a paper on Polarized Light. He stated, that he conceived the term "polarization of light" had been hastily adopted, and tended to mislead, by directing the mind to a class of phenomena, with which he thought the effects upon light were by no means to be classed. In fact, he conceived that the phenomena usually attributed to polarization, were only particular instances of the application of a general principle resulting from the very nature of light, namely, that light, when strong, could pass through the substances of several peculiarly constructed media, in a manner which, when its impulse has been previously weakened, which by several means it may be, it could by no means similarly pass. The Rev. gentleman then exemplified in the common optical changes made upon the course of light, and called reflection and refraction, how rays, which before incidence had gone on together, were by these processes so separated as to produce totally separated images, and even successions of images; in this and similar cases, he conceived that the division of the rays was accompanied with a weakening of the force of each part, insomuch that they would now no longer pass through media in the same way that they would have passed previously; and thus, in certain cases, resulted an inability to pass even through regular structures, such as crystals of Iceland spar, tourmaline, &c, without exhibiting phenomena arising out of the peculiarity of such structures, and which afforded diversities, as he contended, fully sufficient to account for all the phenomena usually denominated polarization. He then went in detail over five common methods of polarizing light: viz. 1. By reflections at certain angles from plates of glass; 2. By reflections from similar plates, having their under surfaces blackened, so as to absorb the rays upon their coming to the back surface of the glass, and to this glass he would refer the effects of all polished surfaces, such as varnished mahogany tables and trays, japanned metals, burnished leather, &c., and he instanced the total disappearance of all

diversity of colour from varnished card of several colours, when viewed under certain circumstances, through eye-pieces of tourmaline, Iceland spar, &c. (we omit the detail of these experiments, as every one of them have been shown to be consequences of the undulatory theory of light); 3. By transmitting the ray through certain crystalline substances, such as Iceland spar; 4. By passing the ray through crystals of tourmaline cut by planes parallel to the axis of the crystal; 5. By the use of Nicholls double fusion of Iceland spar, of the action of which upon light, the rev. gentleman took, as it appeared to us, an entirely erroneous view, for he stated that the rays which had been separated within these prisms, were reunited upon their emergence, whereas the very nature of the prism is to prevent that reunion, by causing a total reflection of the ordinary ray at the oblique common surface of the two prisms, (between which, the Canada balsam is interposed). The rev. gentleman then proceeded to explain, in connexion with his theoretic views, the play of colours observed within certain kinds of crystals of Iceland spar, the distinction between right-handed and left-handed quartz crystals, and numerous other instances derived from facts familiar to those who have studied this branch of science.

Section B.—CHEMISTRY AND MINERALOGY.

President - Rev. Professor Cumming.

Vice Presidents--Dr. Dalton, Dr Henry
Secretaries--Dr. Apjohn, Dr. C Henry, W. Herapath, Esq

Committee--Dr Barker, Professor Daubeny, Charles T Coathupe, Esq., Rev. W Vernon Harcourt, Professor Hare, Professor Johnston, George Lowe, Esq, F R. S. Professor Miller, Richard Phillips, Esq, Dr. Roget, Dr Roger, D Thomson Dr. Turner, Dr. T Thomson, T. Thompson jun., Esq., Henry Hough Watson, Esq., William West, Rev. William Whewell, Dr. Yellowly, Colonel Yorke.

Mr. Watson read a paper on the Phosphate and Pyrophosphate of Soda;—one, however, of so much detail, as scarcely to admit of compression. The results at which he arrived are the following:—1st, That Phosphoric acid given off water in being converted into the pyrophosphoric acid, and that hydrogen and carbon are component parts of the former. 2nd, That phosphoric and Pyrophosphoric acids are altogether different,—different in their composition and their atomic weight; that of the phosphoric being 36·1, and that of pyrophosphoric, acid, 31.7. 3rd, That the precipitate given by pyrophosphate of soda and lime water, when calcined, is black; that afforded by phosphate of soda and lime water white. 4th, That, contrary to the prevailing opinion, a solution of the pyrophosphate of soda does not spontaneously change into phosphate. [The statement contained in this paper appeared to us rather startling, and, we must add, inconclusive.]

Mr. Ettrick on a new form of Blowpipe.—The principal novelty in this apparatus was the method employed for maintaining a constant blast independent of hydrostatic pressure. This was accomplished by small bellows, thrown into very rapid action by means of a wheel and pinion, and a stop-cock inserted in the tube connecting the bellows and cylindric reservoir. To prevent the air from being too much compressed, the bellows were furnished with a valve, opening outwards, and which was pressed upon by a spring, the force of which admitted of being very readily varried. From the cylinder there are two eduction pipes, terminated by nozzles, so that by using these, and a pair of lamps, two jets of flame might be brought to bear upon the same object. He also explained, how air might be made to issue from one, and coal, or other inflammable gas, from the other; and exhibited a tube similar to that long since described by professor Daniell, by the use of which a combustible atmosphere might be made to issue from an orifice without any previous mixture in a reservoir.

Dr. Hare, in observing on this paper, incidentally described the apparatus, which he has for many years been in the habit of using, with a view to the fusion of refractory substances; and stated, that the double tube of Daniell had been used by him many years before it was described by the person whose name it usually bears. Dr. Hare stated, that he had also used the double jet, but had long since laid it aside, from a conviction of its inutility.

Mr. Herapath then drew the attention of the Section to the composition of Bath Water, as recently determined by

him, and detailed the methods of analysis which he adopted, and the results at which he arrived. This analysis, which appeared to have been elaborate and exact, was conducted in the following manner: Evaporation to dryness gave the total amount of saline matter. This was resolved into two parts by rectified spirit, which dissolved the chloride of sodium and magnesium, and left the other materials. The residue was treated with muriatic acid and alcohol, and the various matters taken up estimated in the usual way. Finally, what remained undissolved by the acidulated spirit was found to be a mixture of soda, lime, and silex, the relative quantities of which were also determined. His final results would not appear to differ materially from those of other chemists. The total amount, indeed, of saline matter obtained by him was greater, and Dr. Thomson suggested that this was probably not due to error of experiment, but to the circumstance of the waters themselves having actually altered in composition, a fact which, at least in one instance, he had established by experiment.

Dr. Hare next described his Apparatus for the Analysis, on the plan of Volta, of Gaseous Mixtures. It consists of two distinct parts, his eudiometer and calorimeter; in the former of which he measures and confines, and, by the latter of which, he fires the mixture. The combustion is not produced, as in the case of the common eudiometer, by an ordinary electric spark, but by igniting with the calorimeter a fine platium wire, which traverses the gaseous mixture. It is unncessary to give a more detailed account of this very ingenious apparatus, as it is figured and described in the system of Berzelius, which is, no doubt, in the hands of every chemist.

We should not, however, omit to notice a very interesting application which Dr. Hare makes of his calorimeter—namely, to the blasting of rocks. By this machine the powder can be fired at a great distance, and several trains also at the same instance,—of course, without endangering the lives of quarrymen; and, should an immediate explosion not take place upon setting the calorimeter in action, by replacing this instrument in the inactive state, which is done in an instant, the train may be approached, without fear that its ignition will ensue,—a thing which, according to the ordinary modes of blasting, can seldom be done with impunity. He also alluded to an apparatus, in which silicon and boron can be readily obtained by igniting with his calorimeter potassium enveloped by the fluosilicic or fluoboric gases, and complained that an account of this instrument, which he forwarded several years ago to the Annals of Philosophy, had been suppressed.

Mr. Herapath read a short paper on an Aurora Borealis, visible in this city on the 18th of last November, and suggested as the true theory of this very interesting, but rather perplexing, phenomenon, that it is due to the escape of electricity in streams from an excited cloud, enveloped by an atmosphere in a state of relative dryness. This view was supported by Dr. Exley and other gentlemen, who had observed them in several parts of Great Britain and Ireland, but was ably and energetically opposed by the President, Dr. Dalton, who contended, that Auroræ occur at altitudes far above the region of the clouds, and also very frequently when clouds are altogether absent. Mr. Herapath, in corroboration of his views, urged, upon the authority of Sir H. Davy, that electricity in motion through a very rarefied atmosphere would be productive of no light; but this statement was contradicted by Drs. Dalton and Hare, and would certainly appear to require confirmation, for it is inconsistent with experiments made in an artificial vacuum. In connexion with this topic of the Aurora, Dr. Hare entered into some details, tending to prove, that within a *Tornado,* such as often occurs within the Tropics, there exists a partial vacuum,—a circumstance which he attributes to an electric discharge, which passes between the earth and the space beyond our atmosphere. In both these regions, *oceans* of electric fluid are, to use a phrase of the Doctor's, accumulated; and to the discharges which took place between them, and between each, and charged clouds he seemed to refer all the phenomena of atmospherical electricity. This hypothesis is undoubtedly novel; but, as far as it appears to us, not in very strict accordance either with facts, or the fundamental principles of electrical science. It did not excite any discussion.

SECTION C.—GEOLOGY AND GEOGRAPHY.
President---Rev. Dr BUCKLAND.
Vice Presidents---R GRIFFITH, Esq., G. B. GREENOUGH, Esq.,
(For Geography) R. I MURCHISON, Esq.
Secretaries---W. SANDERS, Esq , S. STUTCHBURY, Esq., T. J. TORRIE, ESQ.
(For Geography) F HARRISON RANKIN, Esq
Committee---H T. De la Beche, Esq., M. Van Breda, Jos. Carne, Esq , Penzance, Edward Charlesworth, Esq , Major Clerke, Lord Cole, Rev. William Conybeare, R. Griffith, Esq , Rev. William Hopkins, Robert Hutton Esq , Boscawen Ibbostson, Esq., Rev. T. T. Lewis, James Macadam Esq , Sir George Mackenzie, M. Van der Melen, Lord Northampton, Professor Parigot. Professor Philips, Professor Sedgwick, William Smith Esq., John Taylor, Esq , Dr. William West, Samuel Worsley, Esq., Rev. James Yates.

G. B. Greenough Esq. in the chair.—A memoir was read by Mr. E. Charlesworth, being a notice of Vertebrated Animals found in the Crag of Norfolk and Suffolk. The principal object in bringing forward this subject was to establish the fact of the remains of mamiferous animals being associated with the mollusca of tertiary beds above the London clay, in the eastern counties of England. These remains are confined to the part of the Crag formation, which appears to extend from Cromer, in Norfolk, to within a few miles of Aldborough, in Suffolk, and the depth of which was very great, wells having been sunk in without reaching its bottom. The bones of fish, and a large portion of the testacea met with in the stratum, differ widely from those of the coraline beds, and from that part of the Crag deposit which skirts the southern coast of Essex and Suffolk. Among the mamalia, which the author states really belong to the Crag, is the *Mastodon augustidens*, of which several teeth have recently been obtained in Norfolk from localities adjoining the parish of Withingham, the spot from which D. W. Smith states the specimen to have been procured which is figured in his ' Strata Identified' Mr. Charlesworth conceived the discovery of the remains of the mastodon in this formation, as affording an argument to prove the relative ages of rocks, as no remains of this animal have been found in America in beds more ancient than the diluvial. The remaining genera of mammiferous animals can be identified with those now existing, or with such as are found in diluvial and lacustrine deposits. The author next notices the discovery of the mineralized remains of birds, chiefly bones of the extremities of natatorial tribes, a solitary instance of a similar discovery in America being the only one recorded. He was not prepared to speak concerning the different kinds of fish, but he stated their distribution—species of Squalus being found near Orford, and what Agassiz conceives to be Platex, at Cromer. Among the most remarkable is the Carcharias Megalodon, the teeth of which are found in Suffolk, is equal in size to specimens from the tertiary formations of Malta. He also alluded to the difference of the testacea in different parts of the Crag, from which he was inclined to infer there were several eras in its formation. No traces of the existence of reptilia have yet been detected, which would rather support the opinion of Dr. Beck and Deshayes, that the climate during the Crag epoch was analogous to that of the Polar regions.

Professor Sedgwick stated that he had long been aware of the existence of remains of mamalia in the Norfolk Crag, although this kind had been disputed by Mr. Conybeare, in his work on the Geology of England and Wales. He was rather inclined to consider the Crag as all of one epoch; and Mr. Lyell had found existing species as numerous in the lower as in the upper Crag. With regard to Mr. Charlesworth's idea of the extinction of the mastodon in England before the formation of the diluvial beds, Professor Sedgwick conceived that was reasoning from a negative fact, and that until more extensive search had been made, no such inference could be fairly drawn. He also mentioned that remains of the beaver were found in the alluvions of Cambridgeshire, and that it may have existed in England a thousand years ago. He was confident that no cause still in existence could have produced the diluvium on the Crag; its whole appearance suggested the idea of a great rush of waters.—Mr. Conybeare was perfectly willing to correct his opinion respecting the existence of the remains of mammalia in the Crag. He was of opinion that that tertiary strata of America had not been sufficiently examined to justify the conclusion that it did not contain remains of the mastodon. He started a question—which of the species of mastodon found in other countries did the British one resemble?—Mr. Greenough mentioned, as a singu-

lar peculiarity of the diluvium of Norfolk, its containing large masses of chalk, and these have imbedded organic remains, differing in some respects from those of the chalk *in situ*. The town of Cromer seemed to be built on an immense block of chalk, contained in the diluvial formation.—Mr. Murchison dissented from Mr. Greenough's opinion. He conceived the formation of chalk was under the diluvium, and had been elevated and disrupted. He had seen at Hazeborough large platforms of chalk laid bare after a storm; near that place were needle-shaped rock's of chalk, and at Cromer the foundation of the town must rest on part of the same mass. There were strong reasons for believing that the Norfolk diluvium contained recent shells only. Mr. Lonsdale, on examination, could discover no others.—Mr. Charlesworth mentioned that Dr. Beck considered the shells of the tertiary period to be extinct species, and that at the formation of the Norfolk Crag the climate must have been very cold, like the Arctic regions. He considers the diluvial formation to have been sufficiently searched to warrant an opinion that it does not contain the remains of the mastodon. Many singular organic remains have been found there, which have been transported, as of saurians, which must have come from Yorkshire. In alluding to the fact of shells similar to those of the Crag being found at Bridlington, he was informed by Mr. Sedgwick that the formation at that place was probably part of the Crag.

A paper, by Mr. J. G. Bowman, was now read, on the Bone Caves at Cefn, in Denbighshire. A description of these has been already published in the *Philosophical Journal;* and the proprietor of the place, Mr. Lloyd, was about referring the investigation of its phenomena to Dr. Buckland. The caves are in carboniferous limestone. The roof of the lower cave is covered with stalactites, which are often broken off or blunted. The diluvium on the floor contains fragments of slate, and the upper portion animal remains in great abundance Among these are some of a very minute size, and also elytra of beetles. A black matter is also found, with veins of reddish clay. The bones are often in fragments, the teeth are something worn; sometimes the teeth of young animals, but no indentations have been found upon them, No skulls have been discovered, nor any caprolites. The bones frequently contain gelatine, and have often manganese upon them; hair was also discovered. The stalactites seem confined to the anterior part of the cave; in the posterior part a fine sand is found.

After this, a desultory conversation took place on the exhibition of two models by Mr. Ibbotson, one of the country round Neufchatel, in Switzerland, and the other of a part of the Under Cliff in the Isle of Wight, extending from Blackgang Chine to St. Laurence.

Mr. Greenough mentioned a new mode of engraving medals lately adopted in France, and which he conceived could be advantageously employed in laying down the varieties of surface on maps.*—Mr. Griffiths spoke of the great importance of models, like Mr, Ibbotson's, as being so well calculated to display the geological structure of a country. He suggested the importance of possessing maps, both of outline and of features, and he alluded to the magnificent map of Ireland, under the Ordnance Survey, the scale of which, being six inches to a mile, enabled the geological observer to trace the geological features with a facility before unknown. It was mentioned, that the new map of Austria was on a scale of twenty-two inches to the mile, but this Mr. Greenough considered inconveniently large. Mr. Ibbotson stated that models could be easily multiplied by employing a metal mould, and using *papier maché*, or some preparation of caoutchouc; and that they might be dissected to exhibit the internal structure, and that materials of the strata themselves could be used as colouring matter.—Lord Northampton and M. de la Beche gave their testimony of approval.—Several gentlemen then spoke of the application of combinations of letters to geological maps, to express the more minute geological phenomena; but the general opinion was, that in geological maps simplicity should, as much as possible, be preserved, and that the best mode would be to have two maps of the same district, one without names, for the geological map, and the other with the ne-

* We shall take an early opportunity of giving some information on this interesting subject.

cessary writing. Maps of this kind had been given to the Geological Society by the Archduke John of Austria.

SECTION D.—ZOOLOGY AND BOTANY.
President—Professor HENSLOW

Vice Presidents—Rev. F. W. HOPE, Dr. I. RICHARDSON, Professor ROYLE.

Secretaries JOHN CURTIS, Esq., Professor DON, Dr RILEY, S ROOTSEY, Esq

Committee—William Yarrell, Esq., Rev Mr Jenyns T. Mackay, Esq., C Babington, Esq., Professor Nilsson, Hon. Charles Harris, Rev Mr Phelps Richard Taylor, Esq., T. C Eyton, Esq., E Bowman, Esq W C. Hewitson, Professor Scouler, Dr. Jacob, Rev Mr. Ellecombe, G . . Jeffrys, Esq., R M Bail, Esq., Colonel Sykes, J L. Knapp, Esq.,—Vigors, Esq. E Forster, Esq

Dr. Richardson commenced the proceedings of the Section, by reading the introductory portion of his report 'On the Zoology of North America.' It did not appear probable that the progress of colonization had, as yet, extinguished any one species of animal from the country. The great similarity existed between the animals of North America and those of Europe, as regarded their generic distinctions, connected with the dissimilarity of their species, rendered them well adapted to inquiries connected with their respective geographic distribution. Hitherto, the trivial names bestowed by the colonists upon many of those of North America, had tended to mislead naturalists. The observations, in the present report, would principally refer to the western parts of North America, including New Mexico, the Peninsula of Florida and California, down to the well-defined limits of the very different South American zoological province. Dr. Richardson then proceeded to describe the physical structure of this country, of which the Rocky Mountains formed a most remarkable feature. The altitude of many of their peaks rose above the limits of perpetual snow, and their sides were flanked by zones of different temperature, affording passages for animals from the Arctic circle to the Table Lands of Mexico, without any great alteration of climate throughout the whole extent. The temperate zones of both hemispheres might, in this way, be connected, were it not that the Cordilleras were greatly depressed at the Isthmus of Panama, and that a plain extended from sea to sea, a little further to the south. As yet, we possess no information of the elevation of the backs of these mountains, independent of the heights of some of the peaks, and the elevation of the base of the range is equally unknown. The depths of some of the transverse valleys are considerable, and these afford passages for the migration of animals. Most of the principal rivers flowing to the east cut across the chain, and one actually rises to the west of the crests of the range. On the Atlantic side, are prairies, composing plains, gently inclining to the east, and there is an extent of land which may be likened to a long valley, which stretches from the Arctic sea to Mexico, without any transverse ridges dividing it, but merely affording three distinct water-sheds. The greatest width of the plain is about 15° of longitude, in the 40° to 50° of north latitude. This configuration gives great facility for the range of herbivorous quadrupeds from north to south, and for the migration of low flying birds, whilst the Mackenzie furnishes a channel by which the anadromous fish of the Arctic Sea can penetrate 10° or 11° of latitude to the southward, and the Mississippi enables those of the Gulph of Mexico to ascend far to the north. The most remarkable chain east of the Mississippi, is the Alleghanies, which are about 100 miles broad, rise from a base between 1,000 and 1,200 feet, and attain an elevation from 2,000 to 3,000 feet above the sea. The strip of land between them and the Coast is two hundred miles broad in Southerly to the 5° of latitude these forming also the Carolinas; becomes broader still in Georgia, and sweeping round the northern extremity of the chain, joins the valley of the Mississippi. This strip influences the distribution of animal life, by extending a barrier to the progress of anadromous fish from the Atlantic to the bottom of the Gulph of Mexico. With reference to Physical Geography, Newfoundland appears as a prolongation of the Atlantic coast line, and its zoological and botanical productions correspond to those of Labrador.

When the canals already projected shall have opened a communication between the several great inland seas which exist in North America, an interchange will take place between the fish of widely diverging waters.

The great proportion of water to land, forms a striking feature of the north-east continent. This may be zoologically divided into two districts—viz. the northern or barren grounds, and the southern, or wooded. The temperature is here materially influenced by the inland sea of Hudson's Straits, and thus its capability of supporting animal life much affected. On the west of the Rocky Mountains, the northern corner appears to be similar to the eastern side or barren grounds. The general character of the country bordering the Pacific is mountainous.

With respect to the climate of North America, the eastern coast has a lower mean temperature than the western, at least in the higher latitudes. Probably the isothermal, and even the isothæral lines of the banks of the Columbia and New Caledonia correspond nearly in latitude with those of the east coast of Europe. But on the eastern side, down to the 56th parallel of latitude, the subsoil is perpetually frozen. Even in the 45th parallel, on the north side of the great Canada lakes, there is upwards of six months of continual frost, and the grallatorial and most of the graminivorous birds can find nothing to subsist them in the winter season; and, consequently, the migration of the feathered tribes is here much more general than in the countries of Europe lying under the same parallel. The pricipal cause of this great difference between the climates of the eastern and western districts, may be ascribed to the configuration of the coast land, which detains the ice in its bays and gulfs, and this, in melting, materially depresses the summer heat. The decrement in the mean annual heat, corresponding to the increase in latitude, is greater in North America than in Europe, and there exists a wider difference between the temperatures of summer and winter, Dr. Richardson then concluded this introductory portion of his report, by details concerning the temperatures which had been observed at different places in the county under consideration.

A discussion then ensued, in which Mr. Rootsey, Dr. Fiske, (of America,) Rev. G Tibbetts, and Mr. G. Webb Hall, took part, respecting the best mode of obtaining both a registry of facts and an appreciation of the causes upon which atmospheric changes depend, with a view to improve our knowledge of the law by which climate is regulated. It was thought that a proposition might be made by this Section, recommending a scheme for instituting both local and general observations to this effect.

Mr. Rootsey exhibited a living specimen of a large spider, which he considered to be the *Aranea avicularia*, Linn,. or *Mygale avicularia*, which was taken at Bristol, in a ship from the Bay of Campeachy, laden with logwood. He noticed some of the extraordinary stories which were commonly reported of this animal, such as its extremely venomous nature, &c., but which he had thus obtained an opportunity of refuting. It was also a common notion, that this species caught humming birds, by springing upon them.—Mr. Lister mentioned, that he had seen a living specimen, obtained likewise from a vessel coming from the same port, and that it fed very readily on a beetle, which was presented to it.—Mr. Hope did not consider the specimen exhibited as the true *Mylage avicularia*, but believed it to be a closely allied species described by Spix and Martins. He possessed the true *Mygale aviculia* in his own cabinet, and had seen a specimen of this insect which was washed ashore alive in Essex, with many other exotic insects, from a wreck which occurred on that coast.

Mr. Rootsey exhibited specimens of sugar, malt, and an ardent spirit, which he had extracted from mangel wurtzel, and considered that this root might, under certain circumstances, be grown to great advantage in this country, for the purposes of manufacturing the above articles. He considered the opinion of its not being liable to injury from the attack of insects, as erroneous, and exhibited specimens of the common turnip fly, *Haltica nemorum*, which he had found feeding upon it. By the selection of particular geographical strata for its culture, the average crop might be increased from 40 or 50 tons, to 70 tons per acre. He remarked, that the refuse, after expressing the juice, appeared to be nearly or quite as nutritive to cattle as before; and that, by drying this at a peculiar temperature in the malt-kiln, a material was procured which, in smell, flavour, and other qualities, closely resembled malt; excepting that it was slightly bitter, With this malt, an excellent beer had been made. He stated

the several opinions which had been formed respecting the different kinds of sugar obtained from the cane, grapes, and other plants, and had found, from numerous experiments, that the analysis of the sugar of grapes was within the average afforded by those of different cane sugars, of which he considered that there existed two distinct kind. Upon subjecting the sugar from the mangel wurtzel to the same processes as those to which the East India sugars were submitted, he had obtained crystals in no respect different from those of the cane sugar; and he, therefore, considered the two kinds in every respect identical. He considered, that the quarter of a cwt, of the malt from mangel wurtzel was equivalent to a bushel of common malt, for the purposes of brewing. The climate best adapted to the growth of the plant, was that of the valleys rather than on the tops of hills, and from computation, he thought that there were in England about 500,000 acres of land favourable to its culture.

Mr. G. Webb Hall stated, that he had been an extensive grower of this plant, and that from experience, he was not prepared to take so sanguine a view of the benefits likely to be derived from its cultivation as Mr. Rootsey. Although crops might occasionally be grown, which yeilded 60 or even 90 tons per acre, he considered, that 40 was above the average. But it was not the case, that the quantity of sugar to be obtained from any crop increased in proportion to the weight of the crop from the same ground; and in France it was found, that one crop of 20 tons would often yield as much as another of 40. In Essex, it had been found, that the plant which before Christmas yielded sugar would after Christmas furnish only a molasses, incapable of being crystallized. The great difficulty of crystallizing the sugar, arose from the rapidity with which the acetous fermentation took place, and which in our climate it was extremely difficulty to avoid. In the West Indies, the process was accomplished in three days. He considered, that sugar prepared from the mangel wurtzel in England could never compete with that from the cane; and if the manufacture of it were successful in France, it was rather to be attributed to the government regulations, by which it was protected, than to any other cause, even admitting the climate of that country to be more advantageous than that of England for its growth.

Some crystalline fragments of pure white and transparent sugar, resembling sugar candy, and of considerable dimensions, which had been naturally formed in the flowers of *Rhododendron Ponticum*, were then exhibited to the Section, Professor Henslow. There is minute glandular spot near the base, and on the upper surface of the ovarium, whence exudes a thick clammy juice, which, on desication, crystallizes into the substance here mentioned.

Mr. G. Webb Hall read a communication 'On the Acceleration of the Growth of Wheat.' After pointing out the advantages which might accrue to agriculture, from the attention given by scientfic men to certain subjects with which it was connected; and the absolute necessity which now existed for making the most extensive and careful investigations concerning many points of great importance to the success of agriculture, he proceeded to call the attention of the Section to a statement of facts, by which it would be seen that the usual period allotted to the occupation of the ground for a crop of wheat might be very materially abridged. At an average, this might be estimated at ten months, though twelve, and even thirteen, were not unusual, and eight might be considered as the shortest period for the ordinary winter wheat. By a selection of particular seed, and a choice of peculiar situation, wheat sown early in March has been on different occasions, ripened before the middle of August, a period scarcely exceeding five months. Mr. Hall considers it an unquestionable law of vegetation that the offspring of a plant of early maturity itself seeks to become so likewise, even when placed in unpropitious circumstances, and that it recedes with reluctance from the condition of its parent. Hence the seed of a crop which has been ripened in five months has a better prospect of producing another crop equally accelerated than that from a crop which has been longer in ripening. He also asserted that the acceleration of a crop was further promoted by thick sowing, which likewise might be considered advantageous in checking and stopping the mildew.

Dr. Richardson referred to the remark of Humboldt, that in South America the wheat crop was ripened in ninety days from the period of sowing, and stated, that about Hudson's Bay this period was only seventy days. He suggested the probable advantage that might arise from importing seed from the latter country for the purpose of furthering Mr. Hall's views; but this gentleman stated, that he had found that seed imported from a distance (and he had tried some from Italy) was liable to become diseased.—As connected with the subject of the acceleration of the growth of seeds, Professor Henslow mentioned the results of experiments which he had tried upon seeds of a species of Acacia, sent by Sir John Herschell from the Cape of Good Hope, with directions that they should be steeped in boiling water before they were sown. Some of these were kept at the boiling temperature for three, six and fifteen minutes respectively, and had yet germinated very readily in the open border whilst those which had not been steeped did not vegetate. It was suggested that these facts might lead to beneficial results, by showing agriculturists that they may possibly be able to steep various seeds in water sufficiently heated to destroy certain fungi or insects known to be destructive to them, without injuring the vital principle in the seed itself.—Mr. Hope mentioned a practice common in some parts of Spain, of baking corn to a certain extent, by exposing it to a temperature 150° or upwards, for the purpose of destroying an insect by which it was liable to be attacked.—Dr. Richardson mentioned, that the seeds sold in China for the European market, were previously boiled for the purpose of destroying their vitality, as the jealousy of that people made them anxious to prevent their exportation in a state fitted for germination. Upon sowing these seeds he had, nevertheless, observed that some few of them were still capable of vegetating.

Mr. Curtis exhibited some specimens of the terminal shoots of a Pinus, which had been attacked by the *Hylurgus piniperda* and made a few remarks upon the habits of this insect.

Dr. Daubeny communicated to the Section the partial results which he had obtained from a series of experiments he was carrying on at Oxford, respecting the effects which arsenic produces on vegetation. He was led to undertake these experiments from having received a communication from Mr. Davies Gilbert, in which he stated that there was a district in Cornwall where the soil contained a large proportion of arsenic ; and that no plants could grow in it except some of the Leguminosæ. By analysis, this soil yielded him about 50 per cent. of arsenic, in the form of a sulphuret ; the rest being composed principally of sulphuret of iron and a little silica. He had already ascertained that a little of the sulphuret mixed in soils produced no injurious effect on *Sinapis alba*, barley, or beans ; and that they flowered and seeded freely when grown in it. Although the want of solubility in the sulphuret might be assigned as a reason for its inactivity ; yet it was certainly taken up by water in small quantities, and imbibed by the roots of plants. Upon watering them with a solution of arsenious acid, he had found that they would bear it in larger proportions than was pre-supposed. The injurious effects of arsenious acid on vegetation in the neighbourhood of the copper-works of Bristol and Swansea was noticed by Mr. Rootsey; and Mr. Stevens mentioned the circumstance of the trout in some streams of Cornwall having been destroyed by the opening of some new mines in their neighbourhood, from which arsenical compounds were discharged, though the vegetation did not appear to be injured by them; and it was further stated, that horses were considerably injured, and rendered subject to a remarkable disease, by the effects of arsenical compounds in the same districts.

Section E.—ANATOMY AND MEDICINE.

Present Dr. Roget.

Vice Presents Dr Bright, Dr. Macartney.

Secretaries Dr. Symonds, G. D. Fripp, Esq.

Committee—Dr. O'Beirne, Dr Bernard, Dr. James Bernard, S. D. Broughton, Esq., R. Carmichael, Esq., Dr. Carson, Bracey Clarke Esq , E Cock, Esq., J. W. Cusack, Esq , H. Daniel. Esq , J. B. Estlin, Esq , Dr. Evanson, W Hetling, Esq , Dr. Hodgkin, Dr. Houston, Dr Howell, Dr James Johnson, R. Keate, Esq , O King, Esq , Dr Prichard O. Rees, Esq , Dr. Riley, Richard Smith, Esq., J. C. Swayne, Esq., N. Vye, Esq , Dr. Yellowley.

Dr. Roget opened the business by a few words on the nature and objects of the Association, and then, for himself per-

sonally, entreated the indulgence of the members, as he had been lately suffering from a severe attack of ophthalmia. Dr. O'Beirne then read the following Report of the Dublin Committee on the Pathology of the Nervous System :—

"The Committee appointed in Dublin to investigate the Pathology of the Brain and Nervous System, feel compelled on the present occasion to confine themselves to an analysis of the cases of nervous affections, which have come under their observation, during the short period which has elapsed since they have considered themselves to be regularly appointed.

"They are of opinion that, in order to arrive at accurate Pathological conclusions on a subject so extensive and on which the most eminent authorities are found to disagree, a very great number of cases should be first submitted to their examination—then, the symptoms of each case carefully registered, and, subsequently, accurate postmortem examinations made, in the presence of the Committee, to ascertain the structural lesion or lesions which with the symptoms co-existed.

"As far as their investigations have yet extended, they see that the subject, if considered in all its details, will require a considerable length of time before they can accumulate such a number of cases and matured observations, as would justify them in drawing general conclusions.

"Further they have to state, that they have collected some valuable facts relating to injuries and diseases of the nerves, which seem to throw light upon the disputed points of the physiology and pathology of this portion of the nervous system. They are of opinion, however, that more extended observations the branch of the subject, are required to be made. They would also submit the necessity of repeating those experiments on animals, upon which so many authorities rely as a foundation for their doctrines.

"The Committee, influenced by the above considerations, have decided on avoiding for the present, any attempt at drawing general conclusions. They consider it more judicious to collect and arrange for a future Report, should they be re-appointed, the abundant materials, which their opportunities enable them to supply.

"In furtherance of this object, they have been for some time engaged in registering the history and symptoms of cases of nervous affections in the wards of the House of Industry, Dublin, and the different hospitals connected with it.

"This Institution contains, independently of cases of paralysis, (estimated at about 150), the following cases of mental and nervous affections, arranged as follows:—

	Males.	Females
Chronic Insane....	74	179
Epileptic ditto ...	21	33
Congenital Idiots.	69	62
Epileptic Idiots...	14	20
	178	294 Total, 472

"The number of cases which the Committee have hitherto been enabled to examine with sufficient accuracy, amounts to 41. Of these they have made analysis. They also have some cases of affections of individual nerves.

(Signed)
James O'Beirne, M. D.
George Greene, M. D.
John Macdonnell, M. D.
R. Adams, A. M. T. C. D."

"Dublin, August 17, 1836."

Dr. O'Beirne then read a paper entitled, 'An Abstract of a Work on Tetanus,' in which he pointed out the use of tobacco enema, and dwelt at considerable length on the differences between the spurious tetanus and the true.

At the close of the paper, Dr. O' Beirne, in reply to questions put to him by some of the members, observed, that with respect to arguments deduced from the exhibition of poisons, he thought they must be drawn from analogy, and be unsatisfactory ; there was no poison which produced tetanus, without producing other symptoms not peculiar to tetanus, and that all cases referred to in illustration of the subject ought to be shown in all their bearings. One gentleman in relating a case had stated, that there was tenderness of the abdomen, whereas in *real* tetanus there is no such symptom ; and he believed that many others referred to as tetanus, were far from genuine.—Mr. Bracey Clarke stated, that he had observed some remarkable appearances in the bodies of horses which had died of tetanus. The intestines were always constricted, and he uniformly found on dissection, either great congestion, or positive inflammation, of the lungs.

Bleeding had been found to effect a cure.—A member inquired of Dr. O' Beirne, whether he had ever used oil of turpentine in this disease; he had found it beneficial as an enema; the proportion he used was ℥ij oil Tereb. to ʒj of laudanum; and pouring cold water on the head at the same time. Dr. O'Beirne had no objection to the use of the oil, but he wished not to complicate the treatment. Mr. King related a case, which terminated favourably after an immense living lumbricus had been voided.

A short description of a case of Aneurism of the Arteria Innominata, furnished by Sir D. H. Dickson, was then read.

Section F.—STATISTICS.

President.—Sir Charles Lemon, Bart.
Vice Presidents.—H. Hallam, Esq., Dr. Jerrand
Secretaries.—Rev. J E. Bromby, C. B. Fripp, James Heywood, Esq
Committee.—J. W. Cowell, Esq., M. Dupin, Lord King, M. Von Raumer, Right Hon T. S. Rice, Professor Babbage, Dr. Bowring, M. P., T. Wyse, M. P., Rev. E. Stanley, Col. Sykes, Dr. W. C. Taylor, Henry Woolcombe, Esq. J Simpson, Esq, Major Clerk, Porter, Esq., Professor Mounier, Lord Sandon, Lord Nugent, Carpenter Rowe, Esq, Thomas Moore, Esq., Rev. W. L Bowles.

A report was read, entitled 'A few Statistical Facts, descriptive of the former and present state of Glasgow,' by James Cleland, L.L.D. This report was so comprehensive, and entered into such minute detail, both as to the past and present state of the city, that we must be content to extract the more interesting passages.—

Church Accommodation.—In conducting the government census for 1831, Dr. Cleland embraced the opportunity of ascertaining the number of sittings in the churches of the Establishment, and in the chapels of the Dissenters. The results are as follows:—

Sittings in the various places of worship in the city and suburbs, 73,425,—viz. in the Established church, 30,928; Seceders, Dissenters, Episcopalians, and Roman Catholics, 42,497; being in the proportion of only one sitting to 2. 75-100 persons, or 20,291 sittings less than what is required by law, viz. church accommodation for two-thirds of examinable persons. When this statement came to be considered by the religious part of the community, efforts were made to procure additional church accommodation. A society was formed for 'erecting additional parochial churches in Glasgow and its suburbs,' and although it has been instituted little more than two years, upwards of 24,000*l.* has been subscribed, and already six churches are built, or are in course of erection. Assuming the population in 1836 to be 235,000, and that 60 sittings should be provided for every 100 of the population, it is found that although every sitting in every church of every denomination were occupied, there would be a deficiency of church accommodation to the extent of 61,594 sittings. To supply this want 61 additional churches would be required.

Roman Catholics.—Being desirous to obtain an acurate account of the number of Catholics in this city and suburbs, Dr. Cleland requested Dr. Scott, the Roman Catholic bishop, to allow him to examine this register of births and babtisms for 1830, when he found that they amounted to 915; and as he had previously ascertained that there was one birth for every 2947-100th persons in the comunity, he concluded that the number of Catholics in the districts referred to must be 26, 965 souls.—Having a desire to know the increase in the number of Catholics in the city and suburbs during the last five years, he applied to Bishop Murdoch, the coadjutor of Bishop Scott, who also allowed the register of births and baptisms, to be examined, and calculating on the same principle as in 1830, Dr. Cleland considered that the Catholics in this city and suburbs, at the end of 1835, amounted to 46, 138 souls.

Trade.—The increase of trade at Glasgow, in consequence of the improvements on the river, almost exceeds belief. Less than fifty years ago, a few gabbarts, and these only about 30 or 40 tons burden, could come up to Glasgow. The recent improvements have been such, that in the year 1831, vessels drawing 13 feet 6 inches water were enabled to come up to the harbour; and low large vessels, many of them upwards of 300 tons burthen, from America, the East and West Indies, and the continent of Europe, as well as coasters, are often to be found three deep along nearly the whole length of the harbour. During the year 1834, about 27,000 vessels passed Renfrew ferry; and at some period of the year, between 20 and 30 in

one hour. A few years ago the harbour was only 730 feet long on one side; whereas it is now 3340 feet long on the north side of the river, and 1260 on the south. Till of late years there were only a few punts and ploughs for the purpose of dredging the river ; now there are 4 dredging machines, with powerful steam apparatus, aed 2 diving bells Till 1834, the river and harbour dues were annually disposed of by public sale, but now they are collected by the trustees, consisting of the members of the Town Council, and five merchants appointed by them.

Amount of Revenue, Expenditure, and Debt.

Date.	Revenue.	Expenditure.	Debt.
From 1752 till 1770	£147 0 10	£2,680 4 11	£2,533 4 1
1835	31,910 19 3	29,609 13 11	124,003 13 9

It appears from the evidence of Mr. James Russel, harbour master for the department of steam vessels, before a Committee of the House of Commons, in May, 1836, that there were 75 steamers plying to and from Glasgow, tonnage 688,568, and that during 1835 there were 8401 arrivals of steamers, twenty of them of the largest class, and some of these about 200 feet long (equal in length to frigates of the first class).

Amount of Customs Duties collected at Glasgow in Years ended 5th Ianuary.

Year.	Duties £.	s.	d.	Year.	Duties £.	s.	d.
1812	3,124	2	4¼	1825	41,154	6	7
1813	7,511	6	5½	1826	78,658	13	8½
1814	7,419	12	8¾	1827	71,922	8	04
1815	8,300	4	3⅛	1828	74,255	0	1¼
1816	8,422	9	2¾	1829	70,964	8	4
1817	8,290	18	1	1830	59,013	17	3
1818	6,802	1	3	1831	72,053	17	4
1819	8,384	3	4	1832	68,741	5	9
1820	11,000	6	9	1833	97,041	11	11
1821	16,147	19	0	1834	199,913	3	3
1822	16,847	17	7	1835	270,667	8	9
1823	22,728	17	2½	1336	314,701	10	8
1824	29,926	15	0				

It is probable, from present appearances,that the duties for 1837 will amount to 400,000*l.*

Steam Vessels.—The whole race of steam propeling projectors having left the field one by one, without being able to effect the object of their ambition, the ground was occupied by Mr. Henry Bell, who was bred a house carpenter. Having a turn for mechanics, and a great desire to follow out what others had abandoned, he employed Messers. John Wood & Co. of Port Glasgow, to build a boat for him, which he called the Comet, and having himself made a steam-engine of three horse power, he applied the paddles. After several experiments, the Comet plyed from Glasgow to Greenock, on the 18th January, 1812, and made five miles an hour against a head wind, while in a short time, by simply increasing her power, she went seven miles an hour. This was the first vessel that was successfully propelled on a navigable river in Europe; and it is very remarkable, that notwithstanding the great progress in mechanical science, no improvement has yet been made on Mr. Bell's principle, although numerous efforts have been made, here and elsewhere, for that purpose. It is true, that boats go swifter now than formerly, but the propelling system remains the same.—All the new boats, either for the out sea or river trade are of greater engine power, and are much more splendidly fitted up for the accommodation of passengers. The speed is also greatly improved. The Liverpool steam-boats, in 1831. were thought to have made good passages, when they performed the run from Liverpool to Greenock, a distance of 220 miles in twenty-four to twenty-six hours. It is now done much sooner. On Wednesday, 24th June, 1835, the City of Glasgow steam-packet left Greenock and arrived in Liverpool, in the unprecedented short period of *seventeen hours and fifty-five minntes* ; and the steam-packet Manchester left the Clarence Dock, Liverpool, on Monday evening the 15th December, 1834, and arrived in Glasgow, a distance of 240 miles, discharged and loaded her cargoes, and was back again in the same dock, within the short period of *sixty* hours.

The cabin fares of the river boats, are rather less than one penny per mile, and those of the out sea packets rath er more. The fare from Glasgow to Liverpool is 1*l.* 5*s.*

Stage Coaches.—Stage coaches were first introduced into Scotland in 1678. On the 6th August, in that year, Provost Campbell and the other Magistrates of Glasgow contracted with William Hume, of Edinburgh, that he should run a coach between Edinburgh and Glasgow, a distance of 42 miles. The following is an abstract of the indenture, which is rather curious. Hume engaged with all diligence to run a coach with six able horses, to leave Edinburgh every Monday morning, and return (God willing) every Saturday

night; the passengers to have the liberty of taking a cloak-bag for their clothes; the *Burgesses of Glasgow* to have a preference to the coach; the fare from the 1st March to the 1st September, to be 4*l.* 16*s.* Scots (8*s.* sterling); and during the other months, 5*l.* 8*s.* Scots. As the undertaking was arduous, and could not be gone into without assistance, the Magistrates agreed to give Hume 200 marks a-year for five years. The coach was to run for that period whether passengers applied or not, in consideration of his having actually received *two years' premium in advance*, 22*l.* 4*s.* 5½*d.* sterling.

Dr. Cleland has obtained the following curious information from Mr. Dugald Bannatyne's scrap book:—"The public have been so long familiarized with stage-coach accommodation, that they are led to think of it as having always existed. It is, however, even in England, of comparatively recent date. The late Mr. Andrew Thomson, sen, informed me that he and the late Mr. John Glassford went to London in the year 1739, and made the journey on horse-back. That there was no turnpike-road till they came to Grantham, within one hundred and ten miles of London. That up to that point they travelled upon a narrow causeway, with an unmade soft road upon each side of it. That they met from time to time strings of pack horses, from 30 to 40 in a gang, by which goods seemed to have been transported from one part of the country to another. The leading horse of the gang carried a bell, to give warning to travellers coming in the opposite direction; and when they met these trains of horses, with their packs across their backs, the causeway not affording room to pass, they were obliged to make way for them, and plunge into the side road, out of which they sometimes found it difficult to get back again upon the causeway.

Intercourse with Glasgow.—Dr. Cleland has published the names and destinations of 61 stage coaches, which arrived and departed during 313 lawful days, each averaging 12 passengers. This gave 458,232 persons in the year. By 37 steam-boats, 25 passengers each, 579,050; by the swift boats on the Forth and Clyde Navigation and Union Canal, 91, 976; by the light iron boats on the Paisly Canal, 307,275; by the boats on the Mankland Canal, 31,784 and by the Glasgow and Garnkirk Rail-road, 118, 882. These together make the gross number of persons passing and repassing to Glasgow daily amount to 1,587,198.

Populations.—The following table shows the amount of population in Glasgow and suburbs, at the time of the Reformation contrasted with the last government census in 1831:—

In 1560.. 4,500 1740.... 17,034 1831...202,426

The population fell off immediately after the restoration of Charles II,; and it is a curious fact, that it required more than half a century to make up the defalcation.

Mortality Bills.—The marriage registers in this city and suburbs, may be held as correct for all statistical purposes. The same thing applies to the register for burials; and from having been appointed to take the sole charge of conducting the enumeration and classification of the inhabitants of the city of Glasgow and suburbs, for the government census of 1821 and 1831, Dr. Cleland can vouch for their accuracy.

Bills of Mortality are understood to contain a list of Births, Marriages, and Deaths, from parochial registers, at stated periods, in connexion with the population.

Births and Baptisms.	Males.	Females.	Total.
Returns from Clergymen and Lay Pastors......	3281	3116	6397
And still-born to do....	246	225	471
Total...	3527	3341	6868
Of this number there were registered only ...	1678	1547	3225
Nnmber unregistered exclusive of still-born...	1603	1569	3172

The following results are derived from the census of 1830-1.

	Males.	Females.		
Births	3,527	3,341	Excess of Males	186
Under 5 years.	15,422	14,855	Excess of Males	567
Under 10 years	28,549	27,435	Excess of Males	1,114
Under 15 years	39,040	38,155	Excess of Males	885
Under 20 years	47,529	50,411	Excess of Fems	2,822
Under 30 years	62,706	73,419	Excess of Fems	10,783
Entire population....	93,724	103,702	Excess of Fems	14,978
Burials.... ..	2,701	2,484	Excess of Males	217

Probability of Human Life in Glasgow which partakes of a Manufacturing and Commercial Population.—Population, 202,425; burials 5,185; rate of mortality, one in 39 4-100th persons.

In 1820-1, with similar machinery, the population being 147,043; burials, 3,686; the rate of mortality was one in 39 89-100th persons, or, in other words, as near as may be to the mortality of 1830-1.

In the government "Parish Register Abstract," ordered by the House of Commons to be printed, on 2nd April, 1833, it is shown, in Vol. iii. p. 496, that the rate of mortality in the metropolis, on an average of years from 1811 to 1821, was one in 39.7 persons; and the same official document show that on an average, from 1821 to 1831, the rate of mortality was one in 39-8 persons.

In the kingdom of the Netherlands, where the registers are as correctly kept as any in Europe population, 6,166,854; deaths, 158,800, viz. males, 81,742; females. 77,058. Rate of mortality, one in 38 82-100th persons. Births, 207,388 viz. males, 106,481; females, 100,907; there is one birth in 29 72-100th persons.

Births in Glasgow, 6,868; population, 202,426 - there is one birth in 29 47-100th persons. The marriages being 1,919, there is one marriage for 105 4-100th persons. The births being 6-861, and marriages 1,919, there are 3 57-100th births to each marriage. The number of families being 41,965, there are 4 82-100th persons to each family.

Cholera.—From tables, kept by Dr. Cleland and Dr. Corkendale, it appears, that there were three eruptions of cholera, marked by the reduced number of cases. Each eruption had a period of increase, and also of gradual decrease. In the first eruption, persons poorly fed, of irregular habits, and dwelling in the crowded ill-aired parts of the city, were chiefly affected. The second eruption was more severe; the attacks were more spread over the town, and many healthy persons, and in easy circumstances, fell victims to the disease. The last eruption was milder than the second, but still surpassed the first, both in the number of cases, and in the healthy and good condition of many of the sufferers. The total number of cases 6208, is about one for every $32\frac{1}{2}$ of the population. The total number of the deaths, 3,005, is about one for every $67\frac{1}{3}$ of the population. The progress of the disease was such, as to have seized one victim for about every *six*, and to have occasioned one death for about every *thirteen*, families.

Glasgow in 1699.—According to the report of the Municipal Corporation Commission in 1835, there were in the year 1699, 15 ships belonging to Glasgow. The foreign trade amounted to the sum of 20, 500*l.* Scots—that the merchants retailed 20 tons of French wine; 20 butts of sack; 12 butts of brandy yearly, and 1000 bolls of malt monthly. That by the decay of trade 500 houses were uninhabited, and that the rent of those inhabited had fallen nearly a third. That the best houses did not exceed the rent of 100*l.* Scots, and the worst 4*l.* Scots, except some taverns. It appears from an official document, that at that period the city of Glasgow, now the first in point of population and mercantile enterprise in Scotland, was ranked only as the fifth, and that the proportion of every 100*l.* of taxation was, for Edinburgh, 38*l.* 2*s.* 8*d.*—Dundee, 9*l.* 10*s.* 8*d.*—Perth, 7*l.* 12*s.*—Aberdeen, 7*l.* 4*s.*—Glasgow, 2*l.* 13*s.* 8*d.*

Cotton Trade.—The manufacture of linens, lawns, cambrics, and other articles of similar fabric, was introduced into Glasgow about the year 1725, and continued to be the staple manufacture till they were succeeded by muslins. On the 21st of July, 1834, Mr. Leonard Horner, one of the Parliamentary Factory Commissioners, reported to Parliament, "That in Scotland there are 134 cotton mills; that, with the exception of some large establishments at Aberdeen, and one at Stanley, near Perth, the cotton manufacture is almost entirely confined to Glasgow and the country immediately adjoining to a distance of about 25 miles radius, and all these country mills, even including the great work at Stanley, are connected with Glasgow, trade. In Lanarkshire (in which Glasgow is situated) there are 74 cotton factories; in Renfrewshire, 41; Dumbartonshire, 4; Buteshire, 2; Argyleshire, 1; Perthshire, 1. In the six counties there are 123 cotton mills, nearly 100 of which belong to Glasgow.'

Power Looms—have increased greatly of late years—some idea may be obtained of the extent of their use in Glasgow when it is known that in 1831 four houses employed 3040 looms. These looms, on an average, weave fourteen yards each per day. Allowing each loom to work 300 days in a year, these four companies would throw off 10,101,000 yards of cloth, which, at the average price of $4\frac{1}{2}$*d.* per yard, is 189,393*l.* 15*s.* per

annum. The power and hand looms belonging to Glasgow in 1831 amounted to 47, 127, viz. steam looms, 15,127 ; hand looms, in the city and suburbs, 18,537 ; in other towns, for Glasgow manufactures, 13,463. Since that period power looms have greatly increased.

Steam Engines.—There are in Glasgow and its suburbs 310 steam-engines, viz. 176 employed in manufactories ; 59 in collieries ; 7 in stone quarries ; and 68 in steam boats. Average power of engines, 20.46-100th ; total horses' power, 6,406.

Coals.—In 1831 the quantity sent to Glasgow amounted to 561,046 tons, of which 124,000 were exported, leaving for the use of families and public works 437,049 tons.

Average Price of Coals delivered in quantities in Glasgow during Eleven Years.

	Per Ton. s. d.	s. d.		Per Ton. s. d.	s. d.
In 1821	8 4	to 9 4	In 1827	6 3	to 7 3
1822	7 11	to 8 11	1828	5 10	to 6 10
1823	7 6	to 8 6	1829	5 10	to 6 10
1824	7 11	to 8 11	1830	5 10	to 6 10
1825	11 1	to 12 1	1835	6 10	to 7 10
1826	9 7	to 10 7			

Previous to the year 1755, all colliers and other persons employed in coal works were, by the common law of Scotland, in a state of slavery. They, and their wives and children, if they had assisted for a certain period at a coal work, became the property of the Coal-masters and were transferable with the coal work in the same manner as the slaves on a West Indian estate.

Timber Trade.—Messrs. Pollock, Gilmour, & Co., who are chiefly engaged in the North America timber trade, have eight different establishments, that ship annually upwards of six MILLIONS cubic feet of timber, to cut and collect which, and to prepare it for shipment, requires upwards of FIETEEN THOUSAND MEN, AND SIX HUNDRED HORSES AND OXEN in constant employment ; and, for the accommodation of their trade, they are owners of twenty-one large ships, the registered tonnage of which is twelve thousand and five tons, navigated by five hundred and two seamen, carrying each trip upwards of twenty thousand tons of timber at forty cubic feet per ton ; all of which ships make two, and several of them three, voyages annually. It may be truly said that this establishment is unequalled in Europe.

Iron Works in Scotland in June, 1836.

Erected in or about the year's		Furnaces.	Tons.
1767,	Carron Company	5	8,000
1786,	Clyde	4	12,000
1786,	Wilsontown	1	3,000
1790	Muilkirk	3	6,000
1790,	Cleland	1	2,500
1790,	Devon	3	7,000
1805,	Calder	5	15,000
1805,	Shotts	1	3,000
1825,	Monkland	3	8,000
1828,	Gartsherrie	5	15 000
1834,	Dundyvan	4	12,000
	Total	35	92,000

Exclusive of the above furnaces, there are eight additional ones in a state of forwardness—viz. two at Gartsherrie, one at Calder, one at Monkland, two at Somerlie and two at Govan. These eight furnaces will make about 20,000 tons annually.

These works are all in the neighbourhood of Glasgow excepting five, and none of them are thirty miles distant from that city.

St. Rollox Chemical Works.—This manufactory, for the manufacture ef sulphuric acid, chlorid of lime, soda, and soap, the most extensive of any of the kind in Europe, covers ten acres of ground, and within its walls there are buildings which cover 27,340 square yards of ground. In the premises there are upwards of 100 furnaces, retorts, or or fire places, and in one apartment there are platina vessels to the value of upwards of 8,000*l*. In this great concern, upwards of 600 tons of coal are consumed weekly.

Soft Goods Trade.—The establishment of Campbell & Co., now embracing the whole sale as well as the retail business, is the largest of the kind out of London, containing 4842 square yards of flooring, or rather more than an imperial acre. One hundred and thirty-four persons are employed in the sale and counting-house departments of these warehouses. The following is a note of the respective amounts of seven years' sales, which not only shows the progressive increase of Messrs. Campbells' business, but exhibits a fair criterion of the rapid increase and commercial improvement of the city of Glasgow :—

In 1818	£ 41,022	6 4	In 1830	£250,899	9 6
1824	156,284	2 1	1832	312,207	5 8
1827	183,385	6 10	1834	423,021	4 7

The sales during 1835 exceeded HALF A MILLION STERLING. Besides these gross sales, the company manufacture

to the value of from 73,000*l.* to 80,000*l.* annually of the goods thus disposed of, giving employment from this department to nearly 2000 persons.

Post Office.—On the 17th of November, 1709, when the Magistrates of Glasgow applied to Parliament for a riding post between their city and Edinburgh, the whole Post Office revenue of Scotland was under 2,000*l.* The correspondence of Scotland seems to have been at a low ebb at the Revolution, as William III. gave a grant to Sir Robert Sinclair of Stevenson, of the whole revenue of the Post Office in Scotland, with a salary of 300*l.* per annum to keep up the post. After a fair trial, Sir Robert gave up the grant as disadvantageous.

There are four complete deliveries of letters now made daily to every part of the town and suburbs, and an answer may be received the same day to a penny-post letter put into the office, or a receiving-house, in time to be sent out with either of the two first deliveries.

Revenue at the following dates.

In 1781..	£ 4,341	4	9	In 1831 ..	£ 35,612	19	5
1810..	27,598	6	0	1832 ..	86,053	0	0
1815..	35,784	16	0	1833 ..	36,481	0	0½
1820..	34,533	2	3	1834	37,483	3	4
1825..	34,190	1	7	1835 ..	39 954	4	6
1830..	34,978	9	0½				

Markets.—Prior to 1784, when the Highland Society of Scotland was insti tuted, the cattle slaughtered in Glasgow were small and ill fed ; since that time the quality of butcher's meat has been greatly improved. In1763, when deacon Peter Brown became apprentice to the butcher trade, the slaughter of bullocks was not known here ; a few milch cows only were killed through the year. At Martinmas every family that could afford it killed a small Highland cow, which was called their mart, and this served them through the greatest part of the year Dr. Cleland has ascertained, that from the 1st of May, 1827, till 1st of May, 1828, there were 17,840 bullock-slaughtered in this city and suburbs, and 144,900 sheep and lambs. Value of butcher's meat for the above year (details published in the Annals of Glasgow), 303,978*l.* 14*s.* 5*d.*; bread, 177, 266*l.* 10*s.* 8*d.* milk, 67,342*l.* 10*s.* Total value of meat, bread, and milk, 548,587*l.* 15*s* 1d. Since 1821, a great number of rumps of beef has been sent to this market yearly from Edinburgh. In 1835, there were upwards of 7,530 rumps sent here from that city, the average value of each was 20*s.* The rumps are cured as hung beef.

Live Cattle Market.—Prior to 1808, the principal butchers in this city were frequntly obliged to travel a circuit of seventy or eighty miles, to purchase cattle in lots, and to rent expensive parks in the neighbourhood of the city to graze them in. The mode of supply is now completely changed. In 1808 a spacious market place for the sale of cattle was fitted up between the south and north approach to the city in Graham Square, in which there is a com modious inn, stable, sheds, a byre to hold 120 bullocks in view, and 260 pens to contain 9,360 sheep. This marker place, which is allowed to be one of the most complete in the kingdom, occupies an area of 29,561 square yards, or rather more than six imperial acres, is paved with whin, and inclosed from the streets by ashlar stone walls. The dues, which are moderate, were let by auction at Whitsunday 1836, for a period of years, at the annual rent of 1,285*l* a sum which, after paying the interest of the debt, the grount-rent, rapairs, and other expenses, leaves a profit to the trust fund of upwards of *five hundred pounds per annum.*

Public Executions—From 1755 to 1830, both in-clusive, 89 persons have been executed in Glasgow of whom 5 were females. During the first 12 years only six persons were executed, while in the last 12 there were 37. During 66 years previous to 1831, there were 27 in which there were no executions 15 in which there was one each year, 10 two, 7 three, 4 four, 1 five, and 2 in which there were six.

Shops.—In 1712 there were only 202 shops in the city, the highest rent 5*l.* and the lowest 12*l.*, average about 3*l.* In 1831 there were 3184 shope ; some of them were rented at upwards of 300*l.*, the supposed average about 40*l.*

Pawnbrokers.—Prior to 1813 there were no regular pawnbrokers in Glasgow. On the 8th June, in that year, John Graham, a retired town officer, opened a pawnbroker's shop in Bell Street. In 1830 there were nineteen licensed pawnbrokers in this city ; their pledges amounted to 410,400, and the capital employed in the trade to 24'700*l.*

Theatre—It does not appear that any theatrical representation was allowed in this city from the Reformation till 1750, when Mr. Burrell, a teacher of dancing at the Bell of the Brae, gave the use of his hall for that purpose. A temporary theatre was erected against the wall of the arch-bishop's palace in 1752, and in a short time thereafter it was demolished by a part of a congregation who had been hearing the celebrated George Whitfield preach in the High Church Yard, who denounced it as the devil's house. At that period popular feelings against theatrical amusements were so great that dress parties were escorted to the theatre by a military gaurd.—In 1762 the magistrates refused to give their Patronage to Messrs. Jackson Love, and Beate, for building a theatre, and no person could be got to sell ground for that purpose. At length a theatre was erected in Grahamston, and opened in the spring of 1764, by Mrs. Bellamy and other performers. Theatrical representations continued to be so obnoxious to the people, that a mob set fire to the stage, and burned the scenery and machinery on the first night of performance. When the damage was repaired, the performance went on occasionally till 1782, when, at one o'clock in the morning of 16th April, the theatre was burned to the ground. Some time after this a small theatre was built in Dunlop Street and opened in January, 1715; but the play-goers thinking it too small for the city, erected one in Queen Street, which was opened on 24th April, 1805, at an expense of 18,500*l.*, raised in shares of 25*l.* It was let on lease at 1200*l.*, but the lease failed; it was then let at 800*l.*, but this could not be paid. The rent was then reduced to 400., and ultimately, the building was sold at a price only equal to the outstanding debts and ground rent. On the forenoon of 10th January, 1829, this splendid edifice was also burned to the ground; and since that time the play-goers have contented themselves with the old theatre in Dunlop Street.

Newspapers.—The first Newspaper printed in the West of Scotland was the *Glasgow Courant*, which appeared In 1715. It was published three times a week, consisted of twelve pages in small quarto, and was sold for three halfpence or "*one penny to regular customers.*" Since 1715 there have been 18 attempts to establish newspapers in the city, and out of that number 10 survive.

Education.—From the Reformation till 1620, there were numerous Acts of the Scotch Parliament for encouraging learning; but it would appear that these Acts had not much weight with the then Presbytery of Glasgow, as that reverend body, on 18th July, 1604, complained to the magistrates of a plurality of schools. —"They thought that the Grammar School, and that taught by John Buchanan, quite sufficient." In 1816, exclusive of the University, and thirteen institutions where youths were educated, there were 144 schools; including the public institutions, there were 16,799 scholars, of whom 6,516 were taught gratis in charity or free schools. It must, however, be observed, that there were not 16,799 individual scholars, as several of them attended more schools than one. Sabbath Schools were established here in 1786. In 1820 there were 106 schools, 158 teachers, 4668 scholars, viz. boys, 2235; girls, 2433; besides three adult schools where there were 3 teachers, and 25 male, and 54 female scholars. Of late years an improvement in the mode of education has been effected in this city, by the introduction of infant, juvenile, and normal schools; and although a number of benevolent individuals, composing the Glasgow Educational Society have lent their aid in accomplishing this object, every one will acknowledge that but for the unwearied and meritorious exertions of Mr. David Stow, the schools would not have been brought to their present state of perfection.

The Report concluded with an 'Abstract View of the State of Society in Glasgow at various Periods, from which we shall give a few extracts:—

From 1550 to 1600—The Reformation took place during this period. The great body of the people, however, still retained their fierce and sanguinary disposition. This is strikingly marked in thsir being constantly armed; even their ministers were accoutred in the pulpit. The number of murders, cases of incest, and other cirminal acts, which were turned over to the censures of the church' but too plainly point out the depraved character of the people.

From 1650 to 1700—The people had become more civilized, and paid more attention to moral and religious duties.

Towards the beginning of this period, nine covenanters were hanged in Glasgow, aud their heads stuck on pikes on the jail. Their graves were covered with what are called the "Martyr's stones," one of which is now placed on the north facade of the Cathedral.

The Union with England opened up a spirit for trade hitherto unknown in Scotland. This great measure, which met with so much opposition in Scotland, and nowhere more so than in Glasgow, contributed greatly to the prosperity of that city.

At the time of the Union, and for half a century after it, the habits and style of living of the citizens of Glasgow were of a very moderate and frugal cast. The houses, in the early part of this century, were, almost without exception, covered with thatch, and those occupied by the highest class of citizens contained only one public room, a dining-room, and even that was used only when they had company; the family at other times usually eating in a bedroom. The people were in general religious, and, about 1745, particularly strict in their observance of the Sabbath, some of them, indeed, to an extent that was considered by others to be extravagant. There were families who did not sweep or dust their houses, did not make the beds, or allow any food to be cooked or dressed on the Sabbath. There were some who opened only as much of the shutters of their windows as would serve to enable the inmates to move up and down, or an individual to sit at the opening to read. Influenced by a regard for the Sabbath, the magistrates employed persons,, termed "compurgators," to perambulate the city on the Saturday nights, and when the approach of twelve o'clock, these inquisitors happened to hear any noisy conviviality going on, even in a private dwelling-house, they entered it and dismissed the company. Another office of these compurgators was to perambulate the streets and public walks during the time of divine service on Sunday, and to order every person they met abroad, not on necessary duty, to go home. and if they refused to obey, to take them into custody. The employment of these officials was continued till about 1750, when upon their taking Mr. Peter Blackburn, father of Mr. Blackburn of Killearn, into custody for walking on the public green on Sunday, he prosecuted the magistrates for an unwarrantable exercise of authority, and, prevailing in his suit in the court of session, the attempt to compel this observance was abandoned.

The wealth introduced into the community after the Union, gradually led to a change in the habits and style of living of the citizens. About the year 1735, several individuals built houses to be occupied solely by themselves, in place of dwelling on a floor entering by a common stair, as they had hitherto done. This change, however, proceeded very slowly, having been retarded by the effects of the rebellion of 1745, so that up to the year 1755, very few of these single houses had been built. At that period, there were only three houses from Virginia street to Anderston, about a mile distant, excepting a few hovels, malt-kilns, and barns; now the whole line is filled up with elegant houses

Previous to the breaking out of the American war, the Virginians who were looked up to as the Glasgow aristocracy had a privileged walk at the cross, which they trod in long scarlet cloaks and bushy wigs; and such was the state of society, that when any of the most respectable master tradesmen of the city had occasion to speak to these tobacco lords, he was required to walk on the other side of the street, till he was fortunate enough to meet the eye of the patrician, for it would have been presumption to approach him.

Col. Sykes directed attention to the portion of the paper containing the results derived from the bills of mortality, which show that there is an excess of males from I to 15, but from 15, upwards an excess of females. He also remarked, that the common law of mortality, 1 in 59, must be too favourable for duration of life, since Dr. Cleland's returns and the Belgium tables gave the result only 1 in 39, and the French tables give 1 in 44 for the northern provinces, and 1 in 40 for the southern provinces of France. —Mr. Hallam was of opinion that the average obtained in Glasgow for duration of life was not a decisive proof of inaccuracy in the general standard; because the rate of mortality must be greater in Glasgow, which was a close manufacturing town, than in agricultural districts.—Dr. Bowring said, that until the new registration bill came into full operation, the data for calculation

in England must be very imperfect. He thought that the excess of females over males, above the age of fifteen, might be accounted for by the dangerous occupations in which men are engaged after that age, and also from the well-known fact, that male emigration is infinitely greater than female.—Dr. W. C. Taylor observed, that no stronger proof of the inaccuracy of the *data*, hitherto supplied to statisticians, could be given than the fact that the number of unregistered births in Glasgow, according to Dr. Cleland, very nearly equalled the number registered. He had always understood that the Scotch system of registration was superior to the English; and if those registers were actually deficient by one-half, he should be almost disposed to question the accuracy of every conclusion which has been hitherto deduced from parochial and official returns.—Mr. Fripp directed attention to the fact, that the number of Dissenters who objected to infant baptism was much greater in Scotland than in England, and that this might in some degree account for the great desperately between the registered and unregistered births. —Col. Sykes said, that in a report embracing such a vast variety of subjects as that of Dr. Cleland. it was scarcely possible to avoid desultory discussion; he should not, therefore, apologize for passing at once to the subject of pawnbrokers, whose rapid increase in Glasgow was, he feared, no good sign of the comfort or morals of the lower classes of the population.—The Colonel has suggested, said Dr. Bowring, a subject well worthy of the consideration of the Section; namely, how a series of inquiries could be framed which should procure information on topics similar to that now under discussion: in France the government had direct superintendence over the pawn-offices, and thus information in that country was attainable. He did not know how similar information could be procured in England, but he felt assured that an accurate return of the number and nature of articles pledged in pawn-brokers' shops would throw great light on the moral condition of the lower orders of society— Mr. Fripp agreed with Dr. Bowring; and added, that he had procured from Dr. Cleland a return from the largest pawn-broking establishment in Glasgow, by which it appeared that women more frequently had recourse to this mode of raising money than men. As the subject would probably again engage the attention of the Section, he would, with the Chairman's permission, read it. (At this moment the Right Hon. Spring Rice entered the room, and was very warmly cheered.)—Mr. Fripp then read the following return of articles pledged at the largest pawn-broking establishment in Glasgow:

539	men's coats.	84	bed-ticks.
355	vests.	108	pillows.
288	pairs of trousers.	262	pairs of blankets.
84	pairs of stockings.	300	pairs of sheets.
1980	womens's gowns.	162	bed.covers.
540	petticoats.	36	table-cloths.
132	wrappers.	48	umbrellas.
123	duffles.	102	bibles.
90	pelisses.	204	watches.
240	silk handkerchiefs.	216	rings.
294	shirts and shifts.	48	Waterloo medals.
60	hats.		

It was agreed that this subject should be deferred for future consideration; and most of the members intimated their intention of endeavouring to devise some plan by which more extensive information might be obtained on the subject of pawn-broking.

A long and desultory conversation followed on various topics mentioned by Dr. Cleland. The chairman recommended that the discussion of this Report should be resumed at a future day. Col. Sykes recommended the part relating to Education to the attention of the meeting, as that important subject would soon be brought under discussion by a Report from the Manchester Statistical Society, on the state of education in the borough of Liverpool.

SECTION.—G. MECHANICAL SCIENCE.

President—DAVIES GILBERT, ESQ.
Vice Presidents.—M. I. BRUNEL, ESQ, JOHN ROBISON ESQ.
Secretaries—T. G. BUNT, ESQ., G. T. CLARKE, ESQ., WILLIAM WEST, ESQ.,
Committee—Captain Chapman, G. Cubitt, Esq, J. S. Enys., E. Hodgkinson, Esq., Dr. Lardner, Professor Moseley, M. Le Playe. Sir, John Rennie, George Rennie, Esq, John Taylor, Esq., Rev. W. Taylor.

This Section of the Association is an off-set from the Section of Mathematics and Physics. At each of the previous Meetings it has been found necessary to appointment a Sub-Section, for the discussion of a variety of questions, having reference to the application of Physical Science in Mathematics—questions which, in the present mechanical

transition state of society, have great interest and importance, and which, having specially occupied the attention of a certain class of men eminent in science, seem to claim for themselves a seperate discussion. From this necessity resulted, last year, the Sub-Section, which has this year merged in Section E.

At eleven o'clock the Hall of Assembly was filled by Members of the Association, among whom we recognized some of the most distinguished of that class of individuals who, under the name of civil engineers, are working a change in the face of society, more remarkable, and, perhaps, more durable, than any which history has to record of the legislator or the conqueror—conquerors where victory is over space and time, and bloodless, and who achieve it, not by the increase of human suffering, but by the increasing profitable employment of human labour.

The discussions were opened by some observations of Professor Moseley on the theory of Locomotive Carriages.—It appeared to be the object of these remarks, to establish the importance of causing to enter into the discussion of the theory of locomotion on Rail-roads, the friction of the machinery of the locomotive carriage itself. This friction, the Professor stated to be composed of two distinct elements —one of which he termed the passive resistance of the machinery, being that which would oppose itself to a force applied to turn the wheels of the locomotive carriage if it were lifted from the rail-road. This friction he stated to amount, in some cases, to 120lb. and in others, to 170 or 180lb. in the carriages employed on the Manchester rail-road.

Besides this passive resistance of the engine itself, independent as it is of the load, the elevation of rail-road, the velocity, or any other cause which effects the other conditions of locomotion, the Professor stated that there was a second element of the friction of the machinery, which was dependent upon, and proportional to the load, inasmuch as it was dependent upon, and proportional to, the traction, which, in its turn, was dependent upon, and proportional to the load.

The friction of the machinery being thus composed of two elements, one constant, and the other proportional to the load, the Professor stated that the third element of the resistance was the traction itself, being the friction of the train. The resistance being transferred, and operating upon one side of the piston, that which overcame it on the other side was the pressure of the steam, which, supposing the vaporizing power of the engine to be constant, varied inversely as the velocity. Moreover, when the machine had acquired its constant velocity, he stated that these two pressures must have become equal. These results and reasonings he stated not to be new, but not to be generally known: for the application of them to the theory of inclined planes, which followed, he claimed entire novelty. If (said the Professor) a locomotive carriage be made, with its train, to ascend an inclind plane the following modifications will be made in the resistance to the motion of the machine and train. The passive friction of the machine will remain unchanged—the friction resulting from the traction will increase in the proportion in which the traction is increased, —the traction will be increased by the resolved portion of the gravity in the direction of the plane, and it will be diminished, in so far as the friction of the train is concerned, in a ratio proportional to the course of the elevation. This diminution of friction of the train, he stated, nevertheless, to be counterbalanced by the increased distance through which the whole mass is moved; so that, on the whole, its effect was the same as though the whole had traversed a horizontal plane; so that on the whole, the traction of the train, arising from friction, and the friction of the machinery resulting from this cause, remained unaffected by the ascent. Again, the increased traction from gravity in ascent, he stated to be compensated by the diminished traction in descent, or, if the angle be greater than that of repose, by the actual acceleration in descent. But there remains, said the Professor, another element to be considered—namely, the friction of the machinery, which results from that increased traction produced by *gravity* in the ascent. This he stated to have no compensation in the descent,

by the ascent of the carriage the traction upon it might be increased double the friction of its machinery would then be doubled; but, by the descent, the carriage and its train being equally accelerated, the friction resulting from traction would, indeed, be reduced to nothing, but it could assume no negative form compensating the friction of the machinery in the ascent: so that, on the whole, there was lost the whole increased friction of the machinery in the ascent, compensated by no corresponding diminution in the descent. These remarks the Professor stated to apply exclusively to the case of inclined planes having an elevation greater than the angle of repose. The loss of power in this case he stated to be considerable, amounting, perhaps, to one-fifth of the traction, and, since an inclined plane will not unfrequently double or triple the traction, amounting in the whole to a considerable fraction of the force expended and the coal consumed. The great loss of power thus resulting from the increased friction of the machinery in an ascent not compensated in the subsequent descent, the Professor stated to be an element neglected in the computations usually made on the expense of different lines of rail-road.

Dr. Lardner stated his entire concurrence in all that had fallen from Professor Moseley, and then proceeded to enter upon the discussion of a variety of facts of great interest and importance connected with the theory of rail-roads, to which having had his attention of late called by frequent examinations before committees of parliament, he had devoted much time. The traction resulting from friction on a horizontal plane, he stated to have been estimated differently by different engineers, at from 8lb. to 11lb. per ton; from some experiments of his own, made with much care, he concluded it to be about 7½lb., by which sum the traction was increased by each additional ton of loading. He alluded to a variety of circumstances by which this fraction may be modified, and mentioned, in particular, the effect which wetting the rail appeared to have upon it—the carriages, after a shower of rain, travelling with much greater speed and facility than before it; and he suggested, that watering pots might, with great advantage, be placed before a train of carriages, washing the rail continually for the wheels which were to follow it. The condition of the rail opposite to this, of its greatest freedom from friction, was that in which it was covered with particles of earth, triturated stone or dust; to try the effect of this condition of the rail he had strewed sand on the surface of the rail, where it had an inclination above the angle of repose, and had found the friction of this sand sufficient to counteract the tendency of the train to descend by its gravity. It having appeared, from some of Dr. Lardner's remarks that he considered the loss of force produced by the working of a carriage over an inclined plane to result from the necessity of applying the break when the angle is greater than that of repose, and from no other theoretical cause, although practically there was a sacrifice in the working of the engine by reason of the superfluous stream thrown off in the descent, Professor Mosely inquired, whether in the event of the steam thus lost being by some means husbanded from the period when the train commenced its descent, and the break not put on, he would consider any force to be lost in the whole transit of the carriage over the incline. The Doctor having declared that to be his view of the matter, Professor Mosely stated that he had not then fully understood the bearing of his remarks, or did not agree in them. The resistance to the motion of the carriage, he again stated to be composed of a constant element, and an element varying in every case with the traction:—the constant element in working an incline, to be worked round the two sides of a triangle instead of the one side, which it would traverse if there were no incline;—and the other element, varying with the traction, and dependent upon the friction of the machinery of the engine, to be greatly increased in the ascent of the plane, and to be evanescent in the descent; thus presenting itself in the descent in no negative form, under which it might compensate the loss in the ascent.—The Section having been addressed by two of its members, whose names were unknown to us, one of whom stated the method of watering the rails to have been adopted with success on some of the tram-roads in Wales, the President rose and shortly

went over the arguments which had been used, and pointed out some of their practical relations,—mistaking, however, as it appears to us, a remark which had been made, that the effect of the friction of the *train*, as distinguished from the engine, would on the whole, be the same, whatever be the inclination of the plane; this assertion (made by Professor Moseley) he questioned; not, it appears to us, having paid attention to the Professor's explanation, that this friction, varying in amount, as the co-sine of the inclination, and its whole effect being estimated by its amount, multiplied by the distance through which it operates, that product must, both in the ascent and the descent, vary as the product of the length of the plane by the co-sine of the inclination; that is, it must vary as the horizontal base of the plane, and be the same as though the carriage were worked along that base instead of up the plane.

The discussion here terminated, and Mr. Russell, of Edinburgh was called upon to lay before the Section the result of certain experiments, made by him, on the traction of boats in canals at different velocities. The researches of Mr. Russell on this subject had already occupied the attention of the Association, and are published among the reports of its last Meeting; and it is one of many instances that may be produced of the advantages which have been already conferred by it on the cause of Practical Science, that the approbation which was so largely and so justly given to Mr. Russell's communication of last year, has encouraged him to make these further investigations, of which this communication is the result.

On the general principle, of the resistance of fluids to bodies moving in them, was grounded the conclusion, that it would be an impracticable thing to move the cumbrous boats upon canals at any but very low velocities, except by an expenditure of power so great that the ordinary methods of conveyance by roads would be cheaper. It was believed, that the resistance would increase with the velocity, by a law so rapid in its variation, that for two miles an hour speed, there would be four times the resistance of one mile; for three miles, nine times that of one mile; for four, sixteen times; and so on, as the squares of the velocities. Here, there was an obstacle to rapid communication by canals, which appeared insuperable. Mr. Russell has shown that there is practically a circumstance which so completely modifies the application of this principle, that when over a certain point of speed is attained, the resistance, instead of increasing when the speed is yet further increased, in point of fact diminishes. In one of his experiments, he found, for instance, that the resistance to the traction of a canal boat, estimated by a dynamometer, increased with the velocity of its motion nearly according to the law of the squares, up to $7\frac{1}{2}$ miles per hour, being then 330lb; the speed being then increased to $8\frac{1}{2}$ miles per hour, instead of further increasing the resistance, *fell* to 210lb. The speed was yet further increased, and it increased again the resistance to 236lb; yet, less, be it observed, than at $7\frac{1}{2}$ miles; 12 miles an hour brought it to 352lb. Scarcely more than the resistance of $7\frac{1}{2}$ mes. These results, confirmed by a number of others, had manifestly a practical application, and they have been applied to the working of fast canal boats in Scotland. Mr. Russell has devoted himself to the explanation of them. He states, that where the water of a canal is disturbed by any cause, as, for instance, the admission of a rush of water momentarily into one extremity of it, or the impeding of a body moving in it, there is generated a certain wave, whose motion along the canal is altogether independent of the nature or velocity of the impulse given to it, and dependent only upon the depth of the canal; its velocity being precisely that which a stone would acquire in falling down one half the depth of the canal. With this velocity, the wave moves uniformly and steadily to the very end of its motion, moving slower, (if the depth of the canal remain unchanged,) but only diminishes its dimensions, until it disappears, and this not for a very considerable space. He stated, that he had himself followed waves a mile and a half, and that they had been traced unbroken for three miles from the spot where they originated.

The velocity of the wave depending on the depth of the canal, it is manifest, that each canal, differing in depth from another, will have a different velocity of wave, and that each part of the canal

differing from another will alter the velocity of its wave, and thus the waves near the sides will move slower than near the centre of the canal, if the side be shallower than the middle. How, then, have these facts their application to the phenomenon observed? Thus, in the experiment described above the velocity of the wave, ascertained by numerous experiments, was eight miles an hour. As long, then, as the boat moved at three, four, five, six, or seven miles an hour, it remained in the rear of the wave, the wave had no effect on it, as the law of the volocities was the theoretical law. At eight miles an hour the boat was, in point of fact, on the wave, and it might, indeed, be seen about the centre of the boat lifting it out of the water and diminishing the traction upon it.—(See Section A, Tuesday.)

The reading of this paper was followed by a discussion, in which Mr. Whewell, Professor Moseley, and Dr Lardner took a part, and the meeting adjourned.

PUBLIC DINNER AT THE HORTICULTURAL ROOMS.

Nearly 500 persons were present. Dr. Lloyd, Provost of Trinity College, Dublin, in the Chair—supported on his right by the Right Hon. the Marquis of Northampton. Professor Whewhel, Professor Hare (Philadelphia), Davies Gilbert, Esq., Rev. W. Vernon Harcourt, John Taylor, Treasurer of the Association, Dr. Roget, Dr. Macartney, Dr. Bowring, &c. &c. On his left, by Dr. Dalton, Lord Nugent, Professor Peacock, Rev. W. Conybeare, T. Moore, Esq., Sir D. Brewster, Professor Moseley, Dr. Lardner, Dr. Lee, Sir Charles Lemon, Bart, Professor Henslow, &c.— The usual toasts were given, and the customary speeches made; and a little after seven the company adjourned to the

GENERAL MEETING AT THE THEATRE.

Soon after the doors were opened the house was filled—gallery, pit, boxes—from the top to the bottom; and it is presumed that not less than 2,000 persons must have been present. At eight o'clock the Rev. Dr. Lloyd, Provost of Trin. Coll. Dublin, took the chair, as President of last year's meeting. He soon after came forward, and thus addressed the assembled members:—

My Lords and Gentlemen.—Ever since the origin of this Association, I have looked forward to its annual meetings in the assured expectation of the highest intellectual enjoyment; and it is scarcely necessary for me to add, that in these delightful anticipations I have never been disappointed. Indeed, when I consider the purposes for which you are associated, and the powers by which those purposes are to be effected, it would seem to me impossible that any hopes of this kind, however sanguine, should end in disappointment;—for here it is my unspeakable privilege to mix with the *élite* of this great country—with all that are distinguished by talents and attainments in each of the numerous departments of science; and not more distinguished by those high qualifications, than they are by the exalted purposes for which they are met together. Those purposes are, by a more rapid and extensive communication of the lights of science as they are struck out, and by carrying these things home to the doors of all, to awaken to exertion those gigantic powers of mind, which are not confined to a few favoured spots, but which are everywhere to be found; and by establishing a more immediate and intimate communication among those engaged in kindred pursuits—to unite their exertions, as it were, into one simultaneous effort, and thereby to accelerate the progress of discovery in every line in which the mysteries of nature may be penetrated by the ingenuity and perseverance of man.

Leaving to others to seek their intellectual entertainment in the way most agreeable to their own tastes, the efforts of this Association are directed to the investigation of those realities by which we are surrounded; and of the power with which they are invested, which, whilst they point to the being and the attributes of the One Great Source of all Existence, whom to know is to adore, do also constitute the means which He has placed within our reach, and in our hands, for the improvement of this our present condition.

This is a labour in which all of every grade are alike interested, and in which all will, at least, bid you God speed. Accordingly, it will be observed, that

the regards of all, of humble as well as of those in the most exalted stations, are directed towards your proceedings; and that every where multitudes continue to press around you, not merely as curious spectators, but as active workmen. Here the mechanic repairs to lay before you his inventions for giving increased effect to human industry, as well as the philosopher who seeks to render the forces belonging to inanimate matter a substitute for manual labour, and thereby to ease mankind of more than half their toils; and here also the statesman seeks to perfect himself in the knowledge of the nature and extent of the materials at his disposal, for effecting the improvements he contemplates in the social edifice.

Though myself unprofitable spectator of your exertions, I would claim to be considered as one greatly interested in your success. I am fully sensible that this is but a poor claim to the notice with which I have been honoured, and I can assure you, gentlemen, that any language at my command would be no less poor to convey the feelings it has excited; I cannot therefore trust myself in making the attempt, but must confine myself to the simple declaration, that the feelings awakened by your unmerited kindness, far from any admixture of self-complacency, are those of the humblest, as of the warmest gratitude.

With respect to the Presidency itself, with which I have been so highly honoured, I think that it may be compared to a brilliant gem, to which it bears many striking analogies, but chiefly in this, that whilst it dignifies every thing with which it is connected, its own native lustre can neither be impaired nor improved by any adventitious circumstance. Yet in returning this precious gem with my unfeigned acknowledgements, you will permit me to offer my hearty congratulations, that the splendid setting it is now to receive, is in so much better keeping with its own inherent beauty and its inestimable value.

At the conclusion of his address, Provost Lloyd resigned the chair to the Marquis of Northampton, who immediately came forward and said, that he should mark his accession to sovereign power by an act of royal favour. Ladies were, by law, excluded from the platform reserved for the General Committee; but as there were many ladies greatly inconvenienced for want of seats, he would however. without fear of the imputation of tyranny, suspend that law, and invite as many to come upon the stage as it would admit.

The Rev. Mr. Coneybeare (who acted as Vice President), said he would, with much pleasure, countersign and issue the ordonnance.

The Marquis then alluded to the cause which had deprived the meeting of Lord Lansdowne's services: he was sure that there was no person present who did not feel a sympathy for the afflicted father, and a sincere anxiety for the recovery of the suffering son.* The subject was a painful one; but the illness of a young nobleman of such high promise as the Earl of Kerry would, he was assured, be deemed a grievous affliction to all who knew his merits; and secret prayers would be offered for his recovery in every heart in the assembly.

His Lordship congratulated the meeting on the great accession of members which the Association had received in Bristol. Some persons had doubted the utility of these *reunions;* but if any such sceptics were present, he would reply to them in the words of the sublimest epitaph ever written, "Monumentum si quæris, circumspice." Was it possible, when so many enlightened minds were thus brought together,—when such a blaze of light was thus kindled, that its cheering rays should not extend to other minds, and light up in other bosoms the same holy fire? The effects of such assemblages were political and moral. Here were men of every shade of denomination and opinion engaged in one united effort in the cause of science and truth —eminent men from foreign lands, united by the glorious brotherhood of mind, were here assembled, to cement the intellectual union of nations. This he regarded as a political result of the highest and most gratifying order. The moral effect of the Association arose from truth being the great object of all its labours; and every truth directly led the mind to the consideration of the Eternal Being who had given us faculties to appreciate the wonders of his

* Whose death, we are sorry to have to announce as having occurred on the very day of this address.

creation, and the wisdom by which the universe of matter was accommodated to the universe of mind. He alluded especially to Astronomy, as leading us to reflect on the Omniscience

That had framed such laws,
Which but to guess a Newton made immortal.

Every true philosopher was a religious man; and he who was not religious, was *pro tanto* not a philosopher. He need not recommend the foreign members to the attention of the citizens of Bristol: the natal place of Sebastian Cabot was already too well acquainted with the advantages to be derived from commercial intercourse with distant lands. He should, however, try to enlist the ladies in the service of the Association; they already possessed great influence; he would rather see it increased than diminished; he wished that they could persuade their husbands and lovers that science was as beauteous as themselves. Seriously (said his Lordship) much is in their power: the lessons taught by maternal love cling to memory with a fond tenacity which no future instructions can ever attain: they linger there when other lessons have been effaced by worldly cares, or removed by more urgent interests: and who shall say that it was not the maternal affection pointing out the beauties of a shell a butterfly or a flower, that first lighted up the sparks of genius in many an infant breast, which now is shining gloriously forth, the pride and wonder of the world?

Dr. Daubeny, the Secretary, then read the following

REPORT.

Gentlemen,—The practice of the three preceding Anniversaries has prepared you to expect, at the first General Meeting that may be held, a short address, explanatory of the nature of those scientific objects which had chiefly occupied the Association on the former occasion, and, in particular, of the contents of the last published Volume of Transactions, in which the results of your labours are recorded. This it has hitherto been usual for the Local Secretaries of the year to prepare; and it seemed but a fair division of labour that such a task should, in the present instance, be allotted to the one on whom from unavoidable circumstances, the smaller share in the other duties of the office had devolved. It was this consideration, indeed, which reconciled me to the undertaking; for had I not felt that the framing of this Address was only part of the functions of the Secretary that could be discharged at a distance from the intended place of meeting, and that the time of my colleague would be engrossed by the preparatory arrangements, in which from my absence, I was unable till lately to participate, I should have shrunk from the responsibility of a task which involved the consideration of questions of a high and abstruse character, to several of which I feel myself but ill-qualified to do justice. It is therefore with extreme diffidence that I enter upon a task which has, at former meetings, been executed by men so eminent in science and presume, though one of the humblest members of this great body, to exhibit to you a brief sketch of the labours of some of those individuals, whose presence amongst us sheds a lustre over our proceedings, and has contributed, more than any other circumstance, to draw together this great concourse here assembled.

There is, indeed, one circumstance, and one only that gives me some claim to address you I mean that of my having attended at all the meetings of this Association up to the present time, and hence having traced its progress through all its various stages, from its first small beginnings at York, up to this period of its full maturity, and having thus been enabled, by an actual participation in the business of all meetings, to form a juster estimate of the real condition of the Association, and of the services it has rendered to science, than could have been collected by the public at large.

Thus circumstanced, I have become sensible of results, flowing from the meetings of this great body, which can scarcely figure in a Report, or find expression in the accounts transmitted by the periodical press,—I have been struck by the enthusiasm elicited by the concourse of congenial minds—the friendships formed and cemented—the trains of experiment first suggested, or prosecuted anew after being long abandoned; above all, the awakening of the public mind to the just claims of Sciences by the celebration of these Anniversaries.

But it seems almost superfluous to dilate, to those actually present at such a meeting as this on topics of the above description, when the mere fact of their being congregated here in such numbers, conveys the best assurance that such is already their conviction. Nor is it merely the assembling of so large a portion of the respectable inhabitants of this city and neighbourhood, nor yet the attracting from a distance so great a number of the mere amateurs of science, which justifies me in this conclusion, but it is the presence of so many hard-working, so many successful cultivators of physical research, and their devoting to the service of the Association that most valuable of their possessions, their time, which gives me a right to assume, that the minds of those qualified to judge on such matters, are already made up respecting the beneficial influence which this Association is exerting. The volume, indeed, which now lies upon the table, and which contains the results of our last year's proceedings, not only amply sustains the former character of these Transactions, but even shows more strongly than those which have preceded it, the power which the Association has been exercising in the direct advancement of Science. It contains, in the first place, several valuable contributions to our knowledge of Magnetism—a branch of science which, within a few years, stood in a manner isolated from the rest, but which now, thanks to the researches of living philosophers, is shown to be intimately connected with, or rather to be one of the manifestations of that mysterious, but all-pervading power, which seems to be displayed not less in those molecular attractions that bind together the elements of every compound body, than in the direction imparted to the loadstone; perhaps even in the light and heat which attend upon combustion, no less than in the awful phenomena of a thunder storm.

Considering the connexion that subsists between the science of Heat, Electricity, and Magnetism, and considering, likewise, the efforts made with various degress of success, and by men of very unequal pretensions, to develope the laws of each of these sciences in accordance with mathematical formulæ, one cannot wonder that the Association should have been anxious to assign to a member, no less distinguished for the depth of his mathematical attainments, than for the range of his acquaintance with modern science, the task of drawing up a Report on the theories of these three departments of Physics, considered in relation one to the other. This, accordingly, has been executed by Mr. Whewell, whose Report stands at the commencement of the volume.

The point of view in which he was directed to contemplate the subject, possesses an interest to all who are engaged in the investigation of natural phenomena, whatever may have been the particular bent to which their researches have been directed.

All the physical sciences aspire to become in time mathematical: the summit of their ambition, and the ultimate aim of the efforts of their votaries, is to obtain their recognition as the worthy sisters of the noblest of these sciences—Physical Astronomy. But their reception into this priveleged and exalted order is not a point to be lightly conceded; nor are the speculations of modern times to be admitted into this august circle, merely because their admirers have chosen to cast over them a garb, oftentimes ill-fitting and inappropriate, of mathematical symbols. To weight the credentials of the three physical sciences which have been pointed out as mathematical, was therefore a proper office for the Association to impose upon one of its members; and I believe it will be found that no small light has been thrown upon the subject by the manner in which that trust has been discharged.

With regard, however, to Magnetism, which forms one of the subjects of Mr. Whewell's Report, much still remains to be done, before the mathematician can flatter himself that a secure foundation for his calculations has been established; and the materials for this foundation must be collected from such a variety of isolated points, distant one from the other, both in time and place, dependant for their accuracy upon the occurence of favourable circumstances, and, after all, demanding from the observer an uncommon union of skill and experience, that there is perhaps no scientific undertaking for which the co-operation of public bodies, and even of governments, is more imperiously demanded; and the Association has, in consequence, both engaged its members

in the prosecution of these researches, and has proposed to obtain for them the national assistance. To call the attention therefore of the scientific world, in a greater degree, to the present condition of our knowledge as to Terrestrial Magnetism, was the object of Captain Sabine's Report in the present volume of these Transaction; and this he has accomplished by presenting us with an elaborate abstract of the work which Professor Hansteen, of Copenhagen, had published upon that subject.

This mathematician, in the year 1811, constructed a chart, in which were laid down, so far as could be ascertained the lines of equal variation and dip of the magnetic needle in all parts of the world. It is curious to observe the degree of coincidence which exists between these lines representing the distribution of the magnetic force, and the isothermal lines by which Humboldt has expressed the distribution of heat over the earth's surface; and this apparent connexion, the cause of which remains a mystery, is calculated to stimulate our zeal for investigating the phenomena of both. Nor is it less interesting to trace in what degree these later observations appear to confirm the general conclusion arrived at by the celebrated Halley more than a century before. That astronomer had inferred, from a general review of all that was then known with regard to the variation and dip of the needle, that there must be two magnetic axes; whilst the gradual shifting of the line of no variation from west to east, led him to propose the ingenious, though whimsical hypothesis, of a moveable globe existing in the interior of the earth we inhabit, actuated by the same forces as those which propel the hollow sphere surrounding it, and, like it, possessing a north and south magnetic pole. This interior globe, if it be supposed to move with somewhat less rapidity than the exterior shell, might, as he concieved, produce a gradual shifting of poles from east to west, and thus account for the difference observed from time to time in the position of the magnetic axes.

Now the researches of Professor Hansteen confirm the existence of two magnetic axes, though they led him to discard the hypothesis by which Halley accounted for their progressive shifting, which, indeed, the recently-discovered connexion between Electricity and Magnetism gives us hopes of explaining more satisfactorily, as has been shown by Professor Christie in the Report read by him at our third meeting.

Since the publication, however, of the great work to which his Magnetic Chart is appended, Professor Hansteen, aware of the mystery which still overhangs the subject, has been zealously employed in attempting to remove it, by ascertaining the present state and progressive change of the magnetic forces. He has accordingly employed himself in making observations on the line of no variation, or, as he prefers to call it, the line of convergence which passes through Siberia; and, by a fortunate concurrence of circumstances, the north-western expedition lately undertaken by British navigators, has afforded the means of obtaining, at the very same time, corresponding ones on the similar line, which extends from Hudson's Bay through the United States of America. Thus the position of these lines in these two most interesting localities, has been almost simultaneously determined with an exactness before unequalled.

In conjunction with Captain Sabine, Professor Lloyd, of Dublin, has contributed, in another way, at the instance of the Association, to extend our acquaintance with the empirical laws of this interesting department of science. This they have effected by determining the dip and variation of the magnetic needle in different parts of Ireland, which it was considered the more important to ascertain, from the situation of that island in the most westerly point of Europe, at which observations could be instituted.

The distribution of the earth's magnetism through this country was determined by the above-named observers, first by a separate series of observations relating to the force of that portion of the magnetic influence which operates horizontally; secondly, by a similar series on the dip of the needle; thirdly, by means of observations both on the dip and intensity of the magnetic force made at the same time and with the same instruments.

It would occupy too much of the time of the Association, were I to attempt to point out, however briefly, the precautions adopted, and the correc-

tions applied in order to arrive at accurate results. I shall therefore only remark, that the method by which the intensity of the magnetic force was ascertained, resembles in principle that by which philosophers determine the force of gravity. For as a pendulum when set in motion oscillates on either side of the verticle line by the force of gravity, so the needle, when drawn out of its natural position, will oscillate on either side of the magnetic meridian by the earth's magnetic force, and hence, in either case the force may be inferred to vary, inversely as the square of the time in which a certain number of vibrations are performed. In order, however, to arrive at trustworthy results, many precautions must be adopted, which are pointed out in detail in Professor Lloyd's memoir, and in particular one relating to temperature; it being found that the same needle will vary in force about 1-4000th part for every degree of Fahrenheit. Having, however, arrived at a determination of the intensity of the magnetic force at the two extremities of the Island by a sufficiently extended series of observations, namely, at Limerick by Captain Sabine, and at Dublin by Professor Lloyd, and having compared the results with those obtained by means of the same needles at a spot out of Ireland, whose magnetic intensity had been previously settled, by availing themselves of the observations of Captain James Ross, at London, our authors proceed to estimate the relative intensity of the magnetic force at twenty-five different places within the compass of Ireland, by observations made at each of these simultaneously with others at Dublin or at Limerick. They thus obtained data by which to exhibit the law of Terrestrial Magnitism in Ireland, in a similar manner to that by which Humboldt laid down the laws of the distribution of Terrestrial Heat. The same principal was adopted in determining the lines of dip as of intensity, and the general result was obtained, that the angle which the lines of dip in Ireland make with the meridian of Dublin is 560 48', and that the dip increases one degree for every distance 10 of miles in a direction perpendicular to these lines.

The preceding method of estimating the intensity by the number of vibrations in a given time, only applies to that portion of the earth's magnetic force which operates in a horizontal direction. In order, therefore, to determine the whole amount of this force, ovservations, of the kind above alluded to, must be combined with others on the dip. This third series accordingly was instituted at twenty-three different stations in Ireland, and the result arrived at was, that the lines of absolute intensity make an angle of 330 40' with the meridian of Dublin, and that the intensity increased in a direction perpendicular to these lines by the 1-100th part for every 95 miles of distance.

The importance of these researches in extending our knowledge of Terrestrial Magnetism, and affording the data on which a correct theory with respect to this subject may hereafter be based, will be felt even by those who do not fully appreciate the skill and labour they required, and no better proof could be afforded of the substantial benefits arising from such an institution as the British Association, than that of having originated such an inquiry

On the subject of Heat, Dr. Hudson, of Dublin, has detailed some experiments the tenor of which he considers incompatible with the commonly received theory respecting its radiation, which we owe to Professor Prevost, of Geneva, inasmuch as their tendeney would be to establish that cold is equally radiated with heat—a result inconsistent with the notion of the former being a negative quality. He consequently leans rather to the views of Professor Leslie, who supposed heat to be radiated in consequence of the alternate expansion and contraction of the air around, producing a series of aerial pulses.

In compliance with a wish expressed by the Meteorological Committee, Dr. Apjohn has investigated the theory of the Wet-bulb Hygrometer, and communicated an account of his experiments on this subject at the Dublin Meeting. His paper, having been already published in the Transaction of the Dublin Academy, does not appear in our Report, which, however, contains two very interesting communications on subjects of Meteorology.

Mr. Snow Harris has presented a statement of the variations of the thermometer at the Plymouth Dock-yard,

as noted down by the wardens and officers of the watch, during every hour of the day and night, commencing on the 1st, of May, 1832, and terminating in December, 1834, which are also checked by a concurrent series of thermometrical observation, registered every two hours, at the request of the Association, by the late lamented Mr. Harvey.

Thus have been afforded us, for two complete years, observations to contrast with those taken during 1834 and 1835, at Lieth Fort, under the superintendence of the Royal Society of Edinburgh.

Mr. Snow Harris has deduced from an everage of these observations the following important results :—

1st, The mean temperature of various seasons, as well as that of the entire year.

2ndly, The daily progression of temperature.

3rdly, The two periods of each day at which the mean temperature occurs.

4thly, The relation between the mean temperature of the whole twenty-four hours, and that of any single hour.

5thly, The average daily range for each month.

6thly, The form of the curves described by the march of the temperature between given periods of the day and night.

In this manner has been accomplished one of the first undertakings suggested by the British Association to its numbers, and promoted by its funds, and the true form of the diurnal and annual curves in an important station of our southern coast been attained, as a standard of comparsion with that arrived at by Sir David Brewster in the latitude of Edinburgh, and from which they exhibit in the results some extremely curious and important discrepancies.

Professor Phillips and Mr. Gray have presented us with a continuation of those curious observations on the Quantities of Rain falling at different elevations, which had formed the subject of two preceding communications published in these Transactions.

In the first series of these, it had been shown that the difference between the quantities of rain that fell depended on two conditions—1st, the height, and 2ndly, the temperature; the former circumstance determining the *ratio* of the difference between the two stations, and the latter its *amount*.

In the second series he showed that the ratio likewise varied at different seasons.

The present or third series presents us with a formula for expressing these variations, and points out its corespondence with the observations made.

That the quantity of rain which falls should be greater at lower than at higher elevations, is a result which, though at first sight it may to appear paradoxical, is quickly perceived to harmonize with the fact, that drops of rain descend from a colder to a warmer atmosphere and consequently condence a portion of the aqueous vapour which exists suspended in the lower strata. But that the rate of increase should actually be found reducible so nearly to a mathematical formula, is certainly far more than could have been expected, and its successful accomplishment is calculated to give us hopes that other meteorological phenomena, which seem at present so capricious as to baffle all calculation, may at length be found reducible to certain fixed principles. So far as relates to the rain that falls at York, the results are regarded by Professor Phillips as sufficiently complete, but he strongly urges the advantage of instituting in other spots selected in different parts of the kingdom similar observations, which, if executed simultaneously, would mutually illustrate each other, and be likely to throw much additional light on the theory of rain, and on the distribution of vapour at different heights

An important practical paper has been published in our Transactions of this year by Mr. Eaton Hodgkinson, on the effect of impact upon beams. It is a continuation of some researches which he communicated at the preceding Meeting, on the collision of imperfectly elastic bodies. In these experiments he had laid down the general principles relating to the collision of bodies of different natures, and had obtained, amongst other results the following,—namely, that all rigid bodies possess some degree of elasticity, and that amongst bodies of the same class the hardest are generally the most elastic,

It remained to be seen whether this difference in elasticity influenced the force of their impact, and this he has shown in his present memoir not to be

the case, the hardest and most elastic substances producing no more effects upon a beam, than any soft inelastic body of equal weight. Various other conclusions of much practical as well as theoretical importance are stated in the above paper, and the results are severally borne out by an elaborate and careful series of experiments.

Our Foreign Associatie, Mons. Quetelet, has presented to us a sketch of the progress and actual state of the Mathematical and Physical Sciences in Belgium, of interest, not only from the information it conveys, but likewise as the contribution of a distinguished foreigner, who had evinced already his respect for this Association by attending one of its meetings. The appearance of this Report, together with that published in the preceding volume by Professor Rogers, of Philadelphi, on the Geology of North America, I regard as a new proof of our prosperity. It shows that the Association has begun to exert an influence over the progress of Science, extending even beyond the sphere which by its name of British, it claims for its own, and that it has enlisted in its behalf the sympathies, not only of our Transatlantic brethren, who speak the same language, and boast of a common extraction, but likewise of those Continental nations, from whom we had so long been severed.

On the subject of Chemistry, our transactions of this year contain only a short report by Dr. Turner, explanatory of the sentiments of the members of the Committee which had been appointed the preceding year, to consider whether or not it would be possible to recommend some uniform system of Notation, which, coming forward under the sanction of the most distinguished British chemists, might obtain universal recognition. In the discussion which took place when this subject was brought before us at Dublin, three systems of Notation were proposed, differing one from the other, no less in principle, than in the end proposed by their adoption;—the first was that suggested by the venerable founder of the Atomic Theory, Dr. Dalton, who aimed at expressing by his mode of notation not merely the number of atoms of each ingredient which unite to form a given compound, but likewise the very mode of their union, the supposed collocation of the different atoms respectively one to the other, He proposed, therefore a sort of pictorial representation of each compound which he specified, just as in the infancy of writing, each substance was indecated; not by an arbitrary character, but by a sign bearing some remote resemblance to the object itself. This, therefore, may be denominated the Hieroglyphical mode of Chemical Notation; it was of great use in the infancy of the Atomic Theory, in familiarizing the minds of men of science to the mode in which combinations take place, and thus paved a more ready way to the reception of this important doctrine. Even now, it may have its advantages in conveying to the mind of a learner, a clearer notion of the number and relation of the elements of a compound body one to the other; and in those which consist only of two or three elements; a symbolic representation after Dr. Dalton's plan might be nearly as concise as any other. But it would be difficult, consistently with brevity, to express in this manner any of those more complicated combinations that meet us in every stage of modern chemical inquiry, as for instance, in the compounds of Cyanogen, or in proximate principles of organic life.

The second mode of Notation is that in which the method adopted in Algebra is applied to meet the purposes of Chemistry. This method, whilst it is recommended by its greater perspicuity, and by its being intelligible to all educated persons, has the advantage also of involving no hypothesis, and being equally available by persons who may have taken up the most opposite views of the collocation of the several atoms, or who dismiss the question as altogether foreign to their consideration. This therefore, may be compared to the alphabetical mode of writing in use amongst all civilized nations; the characters indeed may differ, the words formed by a combination of these characters may be very various, but the principles on which they are put together to express certain sounds and ideas are in all countries the same.

The third method of Notation, which has been recommended by the authority of several great Continental chemists, and especially of Berzelius, resembles rather a system of shorthand than one of ordinary writing; its express object being

to abbreviate, so far as is consistent with perspicuity, the mode of Notation last described. But although most chemists may find it convenient to employ some of these abbreviated forms of expression, it seems doubtful whether any particular amount of them can be recommended for general adoption, since the necessity for it will vary according to the habits of the individual, the nature of his inquiries, and the objects for which his notes are designed.

A chemist, for example, the character of whose mind enables him quickly to perceive, and clearly to recollect minute distinctions, may find a much more abbreviated style of Notation convenient, than would be at all advisable to others; one who is engaged in the analysis of organic compounds will be more sensible of the utility of such symbols, than another who is conversant chiefly with a less complicated class of combinations: and one who notes down the results of his experiments for the benefit of private reference, and not with any immediate view to others, may indulge in a more concise and complex system of Notation, than would be convenient, where either of the latter objects were contemplated.

As the shortest road is proverbially not always the most expeditious, so in Chemical Notation more time may often be lost in correcting our own blunders and those of the compositor, where dots and commas of many sorts are introduced in the place of initial letters to express certain elements, than was gained by the more compendious method of expression employed. Add to which, in the preference given to one set of dots over another, or in the particular collocation of them, above, below or at the side of the symbol to which they are referred, we have no fixed principle to guide us, and can therefore only be determined by the greater or less frequent adoption of one method than of another.

Perhaps, therefore, all that can be hoped from a Committe of British Chemists would be, to set forward the the various uses of some system of Chemical Notation, the purposes for which each of those brought before them seems chiefly applicable, and the degree of prevalence which one has obtained over the rest.

If I may be allowed to offer my own humble opinion on a point which has been so much debated amongst British chemists, I should remark that for the purpose of rendering more intelligible to beginners the mode in which various bodies are supposed to combine, the Daltonian method of Notation may still be of use, just as pictorial representation often comes in aid of verbal description to convey the idea of a complex object. But that where the design is to state in the clearest, and least hypothetical terms, the nature of a series of combinations, a mode of Notation as closely as possible approaching to that adopted in algebra seems preferable—remembering always that as in algebra we omit certain signs for the sake of greater brevity, so it may be allowable to do in applying its principles to Chemistry, these abbreviations being of course the most advisable in cases where by reason of the greater number of elements involved, the expression of them at whole length would occupy so much space as to prevent the whole from being comprehended at a glance.

The above remarks will not, I believe, be found inconsistent with the spirit of the brief report which Dr. Turner has communicated, and which is to the following effect:—

1st. That the majority of the Committee concur in approving of the employment of that system of Notation which is already in general use on the Continent, though there exist among them some difference of opinion on points of detail.

2ndly. That they think it desirable not to deviate in the manner of Notation from algebraic usage, except so far as convenience requires.

And 3dly. That it would save much confusion if every chemist would state explicitly the exact quantities which he intends to represent by his symbols.

But I must hasten on to those few other Reports which the present volume contains, but on which I shall have the less to say, as they relate to subjects connected with Anatomy and Physiology, of less general interest to a mixed audience.

Dr. Jacob has replied to a query proposed by the Zoological Committee at a former meeting with respect to the uses of the infra-orbital cavites in Deers and Antelopes, and has pronounced them to be designed as the receptacles of a peculiar odoriferous secretion.

Dr. Hodgkin and Dr. Roupell have detailed a series of experiments and observations relative to the specific mode of action of acrid poisons, which, whether at once introduced into the stomach, or the circulation, by injection into the veins, seem to operate primarily in the same manner as irritants to the mucous membrane. The Dublin Subcommittee, appointed for the purpose, have given in a report connected with a subject of great pathological interest, respecting which none but the experienced medical practitioner ought to pretend to pass a decided judgment;—nevertheless, when I look back to the early period of my own professional studies, and recollect the obscurity in which diseases of the heart appeared then to be involved, when their remedy seemed so desperate, as to suggest to one of the most distinguished writers on the subject the motto '*Hœret lateri lethalis arundo*' as appropriate to his work and as significant of the probabilities of cure, and when their very nature was known but partially, and could only be guessed at by methods purely empirical,—when I recollect all this, I cannot refrain from congratulating those of my brethern who are engaged in the duties of the profession from which I am myself a *deserter*, on the discovery of a new instrument of investigation in diseases of this nature, the use of which being founded on physiological principles, seem susceptible of greater improvement and more extended application in proportion as our knowledge of the animal economy advances.

But in order properly to avail ourselves of the indications of desease afforded by the differences of sound transmitted through the integuments by the heart, it is necessary that we should be acquainted with the nature of its pulsations, and of the sounds occasioned by them in a healthy state, and this information it has been the object of the Dublin Sub-committee to embody in the report which was communicated by them last year to the Medical Section.

Such are the principle contents of the volume which records the scientific labours instituted at the express suggestion of the general body, and prepared for its last Meeting; but, exclusively of these, many very valuable and elaborate investigations were submitted to the several Sections without any such solicitation.

I may instance in particular the views with respect to the classification and the geological distribution of Fishes, expounded to us with so much ability by Mons. Agassiz, whose important labour might perhaps have been suspended, but for the timely assistance dealt out to him by this body, and the opportunities which its Meetings afforded, for giving them that publicity which they deserved.

I may point out likewise the important results submitted to the Geological Section by Mr. Murchison and Professor Sedgwick, with reference to the Silurian formations of Wales and Shropshire, and the multitude of facts illustrative of the physical structure of Ireland, which were elicited by the exhibition of Mr. Griffith's Geological Map, an undertaking which, coupled with the researches of Mr. Mackay on the plants indigenous to that country, promises to render us as well acquainted with the Natural History of this portion of the Empire, as we already are with respect to Great Britain itself.

Nor must I forget the researches on Comparative Anatomy laid before the Medical Section by Dr. Houston, who pointed out the existence of reservoirs connected with the veins leading to the lungs in the Cetacea, an admirable contrivance, by which Nature has provided for the unobstructed circulation of their blood, in spite of the enormous pressure which they have to sustain at the great depths to which they are wont to dive.

The Members of the Association had also the satisfaction of witnessing the ingenious manner in which Mr. Snow Harris contrives to render quantities of Electricity appreciable by the balance, like those of any gross material substance; whilst such as could enter upon the more refined branches of mathematical analysis must have listened with profound interest to the exposition given by Professor Hamilton, of the ingenious labours of Jerraud, of this city, in solving Equations of the higher orders.

What proportion of such inquiries may be attributable to the influence of this Association, and how much might have been merely the result of that increased taste for physical research to which the Association itself owes its existence, I do not pretend to determine; this however, at least, must be allowed,

that many of the most important truths communicated, might have been long in winning their way to general recognition, and in ridding themselves of those exaggerated and mistaken views which are the common accompaniments of every infant discovery, had it not been for the opportunities which these Meetings afford, of examining the very authors of them, with respcet to their own inquiries; of confronting them with others who have prosecuted similar trains of research; of questioning them with respect to the more doubtful and difficult points involved; and of obtaining from them, in many instances an exhibition of the very experiments by which they had been led to their conclusions. And it is this personal intercourse with the authors of these great revolutions in Science, which in itself constitutes one of the principal charms of these meetings. Who would not have listened with delight to a Newton, had he condescended to converse on the great truths of Astronomy; to a Jussieu, imparting to a circle of his intimates in his own garden at Trianon, those glimpses with respect to the natural relations of plans, which he found it so difficult to reduce to writing; or to a Linnæus, discussing at Oxford his then novel views with respect to the vegetable kingdom, and winning from the reluctant Dillenius a tardy acknowledgment of their merits? And in like manner, who does not value the privilege of hearing a Dalton discourse on these occasions on his own Atomic Theory, or a Faraday, (who, however, I regret to say, is on this occasion prevented by illness from attending), explain orally the steps by which he has traced the relations between Electricity and Magnetism, although every one is aware that the principal facts, both with respect to the one and the other, have long since been made public by their respective authors, and have been abundantly commented upon by others. And nowhere, perhaps, is it more desirable to instil those sentiments to which I have alluded, than within the precincts of those provincial cities which the Association now proposes to visit. The inhabitants of those great emporiums of Commerce and Manufactures are indeed often enough reminded that processes directed by the guidance of Chemistry and Mechanics constitute the very basis of their prosperity, but they are too apt to regard these and other kindred sciences, as the instruments merely of material wealth, and to deem it superfluous to prosecute them further than they are seen to conduce to that one end. That such notions are short-sighted, even with reference to the practical applications of the Arts, it would not be difficult to show; but I am ambitions to place the question on a higher ground, and the presence amongst us of such individuals as I have mentioned, will do more towards that object than volumes of argument would effect. It will convince us at least, that other roads to distinction besides that of mere wealth are opened to us through the instrumentality of the Sciences, for although, thanks to the spirit of the age, which in this respect at least stands advantageously distinguished from those preceding it, the discoverers of important truths are not, as hertofore, allowed to languish in absolute poverty, yet the debt which Society owes to them would be but inadequately paid were it not for the tribute of respect and admiration which is felt to be their due.

It has indeed been sometimes objected, that too large a share of public attention is in this age directed to the Physical Sciences, and that the study of the human mind, the cultivation of literature, and the progress of the Fine Arts have been arrested in consequence. In what degree the accusation is well founded, this is not the place to inquire, although when we look round upon the many literary characters that adorn this age, we should rather suppose the remark to have arisen from the increasing interest in Science, than from any diminished taste for other studies. If this complaint however had any foundation in truth, it would only supply a stronger argument in favour of an Association like the present, the express object of which is to correct that narrowness of mind which is the consequence of limiting ourselves to the details of a single science, or it maybe, to a single nook and corner of one, and therefore to render the prevailing taste of the times more subservient to mental culture, and therefore a better substitute for the studies it is alleged to have superseded. An Association too, which, with no narrow and exclusive feeling towards those pursuits which it is designed to foster, extends the right hand of fellowship to

men of eminence in every department upon which the human mind can be exercised, and which would have felt that no higher honour could have been bestowed upon its present Meeting, than by the attendance of the great poet, and the great sculptor, who own Bristol as their native city.

To alter indeed the character of the period in which we live, is as much beyond the efforts of individuals, as to fix the time of their birth, or the country and station in which their lot is cast; and it is perhaps inevitable, that an age and country so distinguished above all others for the advancement of arts and manufactures, should attach an increased importance to those sciences on which both the latter are depended. But it is at least cosolatory to reflect, that Providence has attached to every one of those conditions of society through which nations are destined to pass, capabilities of moral and intellectual improvement, and that the very sciences which so amply minister to our physical enjoyments, also afford the means of those higher gratifications which spring from the exercise of the taste and imagination. Thus, although it may not be easy for the citizen to indulge to any extent in studies alien from the pursuits which engross his hours of business, yet it cannot be deemed incompatible with the latter, to mount up to the principles of those sciences which are connected with the arts he practises; to study their relation one to the other; and to acquaint himself with the steps by which they have reached their present eminence. It cannot but be useful to the chemical manufacturer to study the laws of that molacular attraction which binds together the elements of the substances which he prepares; to the mechanic to examine the process of the arts in connexion with the general laws of matter; to the miner or landsurveyor, to inform himself with respect to the physical structure of the globe; to the agriculturist, to become acquainted with the principles of vegetable physiology, and the natural relations of plants.

For my own part, intimately connected as I am, both with the first of the commercial cities, and also with the first of the universities, that welcomed the British Association within its precincts, warmly interested in the prosperity of both, and officiating as Local Secretary on either occasion, I have felt personally gratified at seeing the selection of these places justified by the cordiality of our reception in both, and at witnessing the new vigour which has been infused into the Association, in consequence of the support it has therein received. But how much will that gratification be augmented, if it should be found hereafter, benefit in either case has been mutual; that these Meetings have cemented those bonds of union between the academical and the commercial portion of the British community, which it is so desirable to maintain; and that, whilst the University to which I belong has reaped advantange, by having its attention called to the interest felt in physical sciences generally throughout the kingdom, my fellow-citizens here will in like manner catch the spirit which pervades our body, and will engage in the pursuit of science with a juster conception of its high objects, and with a zeal and devotion to its cause, which will not be less practically useful, because it is stimulated by a more disinterested love of truth; less capable of ministering to the operation of the arts, because it is also rendered subservient to mental discipline and improvement.

John Taylor, Esq. Treasurer of the Association, then read the account of the receipts and expenditure, made up to the middle of July this year; from which it appeared that the

Balance in hand at the last Meeting was	£509	16	3
Received from Members at Dublin, and since	2173	0	0
Amount of Interest, Dividends, &c.	127	10	0
Sale of volumes of their Transaction	375	8	9
	£3185	15	0

The Expenditure was as follows:—

Expenses of meeting at Dublin	£235	18	0
Various local expenses	121	19	0
Purchase of £1000. Three per Cent. Consols	916	5	0
Salaries	230	0	0
Grants for various Scientific purposes	457	0	0
Printing Third Volume of Transactions	517	16	0
Other Printing	54	18	0
Sundries	43	8	7
	£2577	4	7

Leaving a balance in hand at present of about £508.

The total amount of property belonging to the Association at present, including the value of a number of copies of their Transactions, is about 4,564*l.*

Mr. Taylor further states that the number of tickets issued up to that time was at least 1000, the largest number that

had ever been issued at that stage of their proceedings ; the probability, therefore, seemed to be, that the number of members attending the Association would be larger than ever they were before, and the pecuniary benefit proportionably greater.

TUESDAY, AUG. 23.

Section A.—MATHEMATICS AND PHYSICAL SCIENCE.

The president upon taking the chair this morning called upon Mr. Russel, of Edinburgh, for his 'Notice of a Series of Experimental Researches regarding the Laws of the Motions of Waves excited in Water.'

This notice regarded one department of a series of investigations In Hydrodynamics, in which the author has been engaged for three years.—(See Sec. G, Monday.) It was discovered in the course of these investigatins, that the phenomena of waves interfered with the phenomena of resistance, to such an extent, as to render an investigation of the laws of the propagation of waves essential to the farther prosecution of the inquiry into the laws of resistance. The importance also of these inquiries, in connexion with the investigations of Mr. Whewell and of Mr. Lubbock, regarding the tide-wave, gave an importance to the inquiries which had induced Mr. Russel to prosecute the investigation in such a manner, as to render it subservient to the improvement of a department of science, of which the applications are so highly important.

Much confusion has arisen from confounding different species of waves following different laws. Mr. Russell has observed four species ;—1. Waves of the first species are seen in what is commonly called ripple on the surface of a pool ; these may be called dentated, and are not propagated beyond the place of their generation ; 2. Waves of the second species, or *oscillatory* waves, are found when a stone is dropped into a quiescent fluid, and these succeed each other in concentric rings—these are the waves of Newton and Young, and correspond to the second species of Poisson ; they are propagated with a velocity proportioned to the magnitude of the displaced fluid ; 3. The third species of waves are called breakers, surges, and tidal-bores; and 4. The fourth species of waves, is the solitary wave, analogous to the great tidal wave of the ocean ; it is propagated with nearly a uniform velocity. The two last species, the surge and the solitary were, are the subjects of this investigation. It was observed, 1st, When a considerable and permanent addition is made to the volume of a limited portion of fluid contained in an open reservoir, such addition produces an elevation of the surface of the fluid, which is propagated in the form of a solitary wave, moving with a velocity nearly uniform. 2nd, The velocity of the propagation of such waves, is equal to that which would be acquired by a heavy body, in falling through a space equal to half the fluid. 3rd, The length of such a wave is nearly constant for a given depth. 4th. The height of the wave varies with its volume, and must be added to the depth of the fluid, in calculating the velocity according to art. 5th, When the height of a wave exceeds twice the depth, it form ceases to be a form of equilibrium, and it breaks. 6th, When the anterior part of a wave is found at a depth less than that of the posterior portion, and the height is greater than twice the depth, the wave curls forward, forming the common surge. 7th, when the width of a channel diminishes in an arithmetical ratio, the height of the wave increases in a geometrical one, until it exceeds twice the depth, when it breaks.

The Members expressed their satisfaction at the ingenious devices by which Mr. Russell had contrived to effect his observations—as where he noted the arrival of the wave at a given position, by placing a white rod across the top of the canal along which the wave was propagated, and watching its image in the approaching wave: while the inclined part of the wave was passing under it, the reflected image of the white rod was transferred, of course, to a considerable angular distance,; but as soon as the top came under the rod, a very small portion of it being horizontal, the reflected image assumed a position exactly beneath the rod. By this most ingenious contrivance, he was enabled to determine both the velocity of the wave, and, to some extent, its length, and ultimately its form. The clear manner in which his experimental results explained the change of form of the greater wave, by the incompatable velocities of two waves of a lower height, at first generated, un-

til ultimately the two lesser were absorbed by the greater, and disappeared altogether, was unexpected, and surprisingly exact. The manner in which the wave changed its form, piqueing more and more up, as its height became greater and greater, in proportion to the depth of the canal, until at length, upon a shelving bottom, the form ended in the surge of breaker—the manner in which this explained every minute familiar phenomenon, called forth repeated applause; and we would particularize the curved form of the surge along the coast, as by the course marking the equal depth of the bottom below the surface, as soon as that depth reached the surging limit; also the circumstance that the surge frequently made its appearance first at one particular point, and then ran off in a kind of *feu dejoie*, sometimes in only one direction along the curved lines of surging depth, sometimes in both directions; these, and many other particulars, which we find it impossible to insist on, met with the most minute explanation.

The Rev. Mr. Scoresby, better known to our readers as Captain Scoresby, begged leave to ask Mr. Russell whether in waves generated in the deep ocean, as in the Atlantic, this explanation would not lead us to infer a velocity of the wave greater than that of a cannon ball. He also begged to suggest to him the consideration of the effect of deep indentations upon the coast, on the waves; he had known, and he described some instances, where the indented form of the coast had a tranquillizing effect upon the waves of the sea outside, so as frequently to produce almost still water.—Mr. Lubbock put several questions to Mr. Russell, for the purpose of eliciting information and explanation upon topics, on which, from the rapidity with which the interesting results succeeded each other, he had not received full satisfaction. He felt peculiar interest in this question, from its direct bearing upon the tides, a subject to which he had latterly much devoted himself; he asked Mr. Russell, whether any of his experiments had been conducted in covered canals, or whether he had observed any facts connected with the effect of the wind, either upon the height or upon the time of propagation of the wave.—Mr. Russell stated, as we understood him, that he had not used covered canals; that he had noted several of the effects of wind upon both the height and velocity of the wave, but he had only time to note these very roughly, but these effects were both considerable and important, and he was even led to expect, that by this influence will at length be explained among other interesting effects, the surging of the waves in deep seas, which takes place in consequence of the form of the wave being changed into one piqueing up at the top. Mr. Roberts inquired what means of measuring time Mr. Russell employed, and to what part of a second he could observe?—Mr. Russell replied, that he chiefly used ship chronometers, and that he never tried to come nearer than half a second; in that time, as he had in the course of the paper observed, the ordinary wave of the experimental canal he used, progressed about six feet.

Mr. Whewell observed, that experiments had, in some instances, borne the most ample testimony to the correctness of the theory of this intricate portion of hydrodynamics; although, in the greater number of instances, by outstripping that theory, it exhibited the deplorable state of dificiency in which it still existed. The learned Professor congratulated the Section upon the prospect which now brightened before them, for he had little doubt but that these experimental results, in the hands of some expert, analyst, would at length conduct to an advance of the theory which in many branches of science would be of much importance. To himself, the obvious and very close connexion of these researches with the subject of the tides was matter of the most intense interest The learned gentleman then proceeded to particularize some leading and valuable examples of that connexion. The propagation of the great tide wave was a direct case of the propagation of the waves of the species, to the tracing of whose laws Mr. Russell had chiefly applied himself. And this led him directly to an answer to one of Mr. Scoresby's questions; for, since that tidal wave could be shown to be propagated from the Cape of Good Hope to the ports along the coasts of Spain in about twelve hours, surely here was an instance of propagation of these waves in deep waters, not only equalling, but far surpassing, the velocity of a cannon ball.

Sir William Hamilton congratulated Mr. Russell upon the most successful issue of his researches thus far, and strongly urged upon him the continuation of them, and even the extension of of them. The fund upon which Mr Russell drew for bearing the expense of his experiments, conducted, as they had obviously been, upon the most splendid scale, of course left nothing to be desired if it still continued unexhausted; but to him it appeared that if there was the least chance of a difficulty in procuring funds, those of the British Association could not be applied to a more legitimate or a more important purpose; and he felt little doubt that, if there was any necessity for such application, it would be successful.

Professor Powell then read a paper respecting the Refractive Indices of several substances.

The Professor commenced by giving an explanation of the term Refractive Index, and pointed out the changes of meaning which it had undergone since the time of Newton. He then explained what was meant by the "dispersive power" of a substance. The determination of the refractive indices for definite rays of the coloured image of the sun, or solar spectrum, marked by the dark lines of Wollaston, from direct observations of their deviations, produced by prisms of various substances, was first proposed by Frauenhofer; and, by the aid of instruments of extraordinary delicacy and exactness, executed by him, obtained for ten media solid, and was carried on by Mr. Rudberg for ten more. The absolute necessity of an extended series of such determinations, was pointed out by Sir J. Herschel and Sir D. Brewster, and was further urged by a special recommendation of the British Association; but Mr. Powell, finding that no other person was stepping forward to undertake the task, stated, that he was himself most reluctantly induced to endeavour to make some progress in this matter, so highly important in a practical point of view. The apparatus of Frauenhofer, besides its extreme complexity, required in the using, a skill and accuracy, possessed by few but himself. This, and other considerations induced the learned Professor himself to procure the aid of Mr. Simms in constructing a much simpler apparatus, the essential parts of which are a graduated circle, with the prism of its centre diameter 10 inches—an achromate telescope, with cross wires at its focus—an arm, projecting from the centre, carries the prism with two motions, one to adjust it to parallelism, with the slit through which the light is admitted, and which is about the 1-20th of an inch wide, and then round its axis. For liquid media, hollow prisms, or troughs, of different angles, were provided, whose inclined sides are of plate glass, formed with truly parallel surfaces, and the angles accurately determined previously. For seeing some of the lines of the spectrum, the light of the sun is required, in which case one or more thickness of purple glass is used, and, by means of the lines themselves. the most perfect parallelism of the prism with the slit can be obtained; and, since the lines become indistinct, except in or near the position of minimum deviation, that position is always adopted; this last deviation is accurately observed by the focal wires. The absolute deviation is observed directly from the zero point of the circle, or that which corresponds with the telescope directed to the slit. This instrument, the Professor stated, although comparatively so simple, admitted of a degee of accuracy, even greater than what he cared to wait for obtaining, his object being a great number of approximations to the truth, rather than the attainment of the utmost precision. He then proceeded to notice the care required in attending to diversities of temperature, since he had found the greatest differences to result from this source. He alluded briefly to the precautions used, and then stated the means by which he had obtained the oils, alcohol, and chemical substances, which were the subjects of these experiments, Mr. Allen and Professor Daubeny giving him the most essential aid in this important part of his labours. The fluids that he examined were oil of cassia, oil of aniseed, sulphuret of carbon, balsam of Peru, kreosote, oil of sassafras, oil of pimento oil of angelica, sulphuric acid, muriatic acid, nitric acid, alcohol 39=.815, solution of chromate of lead in nitric acid, solution of chromate of potass, of muriate of lime, muriate of ammonia, nitrate of potass, sulphate of magnesia, nitrate of mercury, muriate of barytes, sulphate of soda, muriate of zinc, nitrate

of bismuth, nitrate of lead, superacetate of lead, subacetate of lead, distilled water the same as that in which the solutions were made. Of these the refractive indices of many were very high, and most of them of such a nature as to render them scarcely possible to be reduced to the proper form. In conclusion he stated, that many crystals of various kinds of substance, if got pure would be invaluable for aiding in these researches—he particularized lead. The learned gentleman concluded by some notice of the researches of Dovey.

Sir David Brewster stated many modes in which some of the most perplexin difficulties met with by Mr. Powell might be avoided. He stated, that he could render very imperfect crystals available by covering up their imperfections with China ink; also, we under stood him to say, that sometimes he interposed silk; but he universally succeeded in making the dark lines visible, by using the triple oxalate of chromium and lead as an interposing substance. He also remarked that it would be very important to note accurately, the angle which the ray or beam of light made with the edge of the refracting angle of the prism, and illustrated its importance.—Mr. Powell showed, that in the very construction of his apparatus this was provided for.—Professor Forbes bore testimony to the extreme simplicity of the apparatus, and its capability of accurate investigations. He had only just come from Oxford, where he had, had the pleasure of seeing and examining it, and from his own experience he could say, that any one, at all accustomed to such experimenting, might be readily trained to use it.

A paper was then read, contributed by Sir. D, Brewster, 'On the Polarizing Structure of the Crystaline Lens of the Eyes of Animals after Death.'

The eyes examined were those of oxen and sheep, the tendency of the lens to indurate was prevented by immersion in distilled water; the polorazing structure was then examined; great changes were stated to take place in that structure in the eyes of aged animals. From these investigations, the writer was led to the results that there is in the crystalline lens a capability of being developed by the absorption of the aqueous humour; that a perfect structure is not produced until the animal frame is completely formed; and that when it begins to decay, the lens changes both its density and focal length, and sometimes degenerates into the disease termed hard and soft cateract. Sir. D. Brewster is led to entertain a hope, that these researches may furnish a means of preventing or curing that alarming disease.

The Rev. J. W. M'Gauley then read 'A series of Experiments in Electro-Magnetism, with reference to its applications as a Moving Power.'

Previously to the detail of the experiments on this subject, he thought it might be interesting to the Section to relate what he had done since the last Meeting of the Association, in the application of electro-magnetism to machinery. He had intended, originally, to have exhibited the improvements, but should content himself, for the present, with the *detail*, rather than the *exhibition*. He was obliged to confess, that he was the less anxious prematurely to publish results, since he found that the working model of last year, given to the section, undoubtedly with the intention of its future improvement, or the pursuance of experiments by other Members, had led' on several occasions, to the production of papers, and the exhibition of models, by those from it might not be expected—with a pretension to originality, but with no change in the principle, and almost in the details.

The working model exhibited to the Sections at the last Meeting of the Association must be acknowledged as a proof, to some extent;. at least, of the applicability and the manageableness of electro-magnetism as a moving power; but the question then remaining was, whether or not it was likely to be applied to useful purposes; for this, several things remained undone,

Powerful magnets were to be constructed. The ordinary formation of electro-magnets furnishes us, at best, with an apparatus clumsy in the extreme, and, as we shall see, of very limited power. This arises from the very nature of an electro magnet; for the lifting power may be very great, although the attracting power at a small distance may be very trifling. There must be a limit, also, to the size of these magnets, for, if the mass of iron be too great for the helix, it is not saturated with magnetism, and the

helex cannot be unlimited, as, beyond a certain distance from the iron, its action is nothing,—in some cases, perhaps, as we shall see, even injurious. The effective distance of the helex from the iron cannot be great, since its action, probably, decreased in the inverse proportion of the square of that distance. The difficulty cannot be obviated, as some have imagined, by causing the electrical currents to circulate through the mass of iron, uniting together a number of coiled bars. This would present an arrangement probably similar to a permanent magnet, the masses of iron acting on each other by induction, the reversion of the poles would be very slow, or altogether impossible. The *action* of the magnets, rather than their *masses*, must be united; but in this, new difficulties occur. Their action must be simultaneous, or the machinery will be broken, or ineffective; the time *after* reversion, and during which a *bar can* be thrown off a magnet, is extremely short—hence one reason why it is difficult to unite the action of several magnets. But let us suppose that we have obtained a simultaneous reversion of the poles and throwing off of the bars—a thing totally impossible, he conceived, from the number and complication of circumstances by which it is influenced—how shall this action be applied to machinery? If the fly-wheel of a steam-engine, from the shutting off of the steam, be not impelled by the engine while it continues in motion, it drags the piston, uninjured, through the cylinder; but suppose something to retain the piston in one position, without stopping the wheel, the effect were highly injurious—this is exactly what must frequently happen in electro-manegetism. It is impossible to reverse the poles even of one magnet, in such a manner that the position of the bars shall always correspond with the position of the crank and fly-wheel.*

Let M M' be two magnets, M M' be the space through which B, the bar, travels in causing half the revolutions of the crank C' X, while B is moving, so that its extremity shall be at P';' then C' X shall have become C' X' while it is going to P", C' X' shall become C' X'" but if when the crank C' X is in the position C' X'" one of the dead points, the bar is not ready to leave M'; or, in other words, if the magnet which holds it be not ready at once to send it off—a thing very probable—the fly-wheel continues to revolve by its own inertia, and the machinery is broken, or the bar is torn from the magnet, which often has a curious and perplexing effect on the reversion of the poles.

A better reversing apparatus was to be obtained.*

Again, the form of the apparatus, whether mercury be used or not, must be *changed*, and the *principle* of the one now exhibited to the Section adopted, since the apparatus, which will reverse the poles of one magnet, will not with speed of certainty reverse the poles of two or more, when worked by the engine itself. The apparatus shown to the Section had been used with great success in the reversion of the poles of four powerful magnets.

The attachment of the reversing apparatus to the machine becomes difficult, when more than one magnet is used, for reasons with which he would not then occupy the Section. He believed he might mention, that he possessed an engine of considerable power, in which these difficulties were overcome.

The experiments he should detail to the Section were numerous and complicated; he had taken every means to secure their accuracy; some of them appear anomalous, but were undoubtedly modified by circumstances, many of which are so obscure, that he has not been able yet to detect them. He remarked, that it was obviously important to make experiments in considerable number, and on a large scale, since the former secures a greater accuracy, the latter the notice of results which, from their minuteness, might otherwise escape observation. His inquiries resolved themselves into two points—the nature of magnetism—the best means of producing it. The means of overcoming the difficulty arising from the necessarily limited size of the iron and the helix, he might probably treat at a future period.

To place everything in exactly the same circumstances, without which a fair comparison could not be made, the battery was cleaned, the charge renew-

* See plate iv. fig 6.

* See Plate iv. fig 1

ed, and the arrangements examined before each of the following experiments, and the materials of the charge were, as far as possible, not merely similar, but identically the same.

First Series. The Helix.

No. 1.—A horse-shoe soft iron bar 13½ inches across, to the extreme edges of the poles, 5¼ interior, 7¾ exterion length. The diameter of the bar 2½ inches, its weight 29½ lb. The keeper used was 13¾ inches long, 2½ wide, ⅝ thick; its weight, with ring, 7¾ lb. This keeper was used in all experiments with magnets of the same size. This, like all the other magnets. was well coated with sealing-wax varnish; it was coiled with 1690 feet of No. 13 copper wire, in 10 equal coils. The battery was one foot square, double cell, charged with 1 in 50 sulphuric acid, 1 in 100 nitric acid, and water.

Keeper distant from poles 3-10 inch, it lifted 4¼ lb. 3-20.............. 9¼

Magnet No. 1, of 5th Series, connected with the battery, at the same time, lifted in contact................ 9½lb.

He removed one of the coils, used the same battery, and a similar charge, at the distance,

3-10 inch, it lifted 7½ lb.
3-20.......... 37
⅛............ 26¼

The one of last year, though perfectly successful, required the agency of mercury, which, for many reasons, is objectionable; it becomes oxidated, then contact is imperfect, and the level in the cups, which is of the last importance, is destroyed: it is liable to a thousand accidents, not speak of its destroying the wires of the apparatus itself.*

The spark, on breaking contact, was very brilliant.

Same magnet, battery, and similar charge, but the poles of the battery and the magnet thicker wire, it lifted at................ 3-10.. 14¼ lb.
3-20.. 24
⅛ .. 32¼

Same magnet, battery, and charge, but thicker zinc plates, it lifted at.......... .... ⅛ .. 32¼ lb.

Same magnet, &c. thinner plate............... ⅛ . 60

Same magnet battery, and charge, one coil of the same wire, 150 feet in length,, ⅛ perceptible in contact........................ 12¼ lb.

Same magnet, battery, charge, &c., 2 separate coils, each 150 feet.................. 1-16.. 5¾ lb.

Same magnet, battery, charge, and coils, the two coils formed into one of 300 feet, at same distance.. .... ¾ lb.

Same magnet, battery, and charge, 3 coils, making together 450 feet.............. ⅜ ... 2¼ lb.
¼ 3¼
⅛ 4½
1-16.. 9¼

The wire was coiled in larger quantity near the poles.

Same magnet, battery, and charge 4 coils, 600 feet, it lifted at ⅜ .... 2½ lb.
¼ 3¼
⅛ ... 3¾
1-16.. 12¼

Wire coiled equally over the magnet.

Same magnet, battery, and charge, 5 coils, 750 feet, at....... ½ perceptible.
⅜ .... 3¼ lb.
¼ 2½
⅛ 4¼
1-16..12¼

Wire rather more on one pole.

Same magnet, battery, and charge, 6 coils, 900 feet, at...... ½ .... 3¾ lb.
⅜ 3
¼ .. 3
⅛ 7¼
1-16. 18¼

Same magnet, battery, and charge, 7 coils, 1050 feet, at...... ½, ⅜ } perceptible
¼ .... 2¼ lb.
⅛ .. 5¾
1-16. 19¼

Wire coiled evenly. Battery diminished in energy almost immediately.

Same magnet, battery, and charge, 8 coils, 1200 feet, at.... ½ .... 7¾ lb.
⅜ 9¾
¼ 4¼
⅛ 8¾
1-16 30¼

Wire coiled more on the poles. When it lifted at 1-16 30¼ lb. its energy was so far diminished as to be at ½ inch scarcely perceptible.

Same magnet, battery, and charge, 9 coils, 1350 feet, at.... ½ ....5¼ lb.
⅜ 6¼
¼ 9½
⅛ 8¼
1-16 .21¼

* See plate iv. fig 1.

Same battery, magnet, and helices, charge 300 drachms water, 10½ sulphuric, 5½ nitric acid.

1-16 . 17¼ lb.

The wire was coiled evenly, and filled the inside curve of the magnet.

SECOND SERIES.

Same magnet and battery, charge 400 drachms water, 8 sulphuric, 4 nitric acid; all the coils remaining on those nearest to the iron connected with the battery, lifted, at 1-16 inch, the following quantities.

Average of a great number of Experiments:—

9 coils.	1350 feet.	19¾lbs.	The ninth helix on this occasion occupied nearly the same place as the tenth on the former, and like it, was injurious to the effect.
8.. ..	1200....	26¾	
7..	. 1050....	22¾	
6.. ..	900....	18¾	
5. ..	750....	13½	
4.. ..	600....	11¼	
3. ..	450....	7¼	
2.. ..	300....	3¼	
1.. ..	150....	2¼	

THIRD SERIES.

Same magnet, battery, charge and helices,

2 helices arranged so as to form but one, lifted at 1-16 inch........ 5¾ lb.

3 helices forming one...... 4¼

4.. . . .. 7¼

5...................... .....6¼

6............................ 0

1............................ 4¾

FOURTH SERIES.

Magnet No. 1, horse-shoe bar, 9⅝ exterior length, from extremity of poles to highest joint of exterior* curve, diameter of bar 1-58 inches, dises surmounting the poles 4 inches diameter, 1-8 thick. Coiled with 500 feet of No. 15 iron wire, in 5 equal helices. Keeper 9½ inches long, 4 3-16 wide, ¾ thick, weight, with ring, 9½ lb., battery 1 foot square, double cell, charge 400 drachms water, 8 sulphuric, 4 nitric acid. Flannel casings of the zinc plates new.

At 1-16 of an inch this magnet lifted 6lbs.

Magnet No. 2, same size, &c. coiled with 500 feet of No. 13 copper wire, in 5 equal helices, same arrangement, battery, and charge.

This magnet lifted at ⅛ inch 4 lb.

1-16.... 7½

* See plate iv. fig 2.

Magnet No. 8, same size, and coilled with 500 feet of No. 12 iron wire, same arrangement, battsry charge, &c.

This magnet lifted at ⅛ .... 1½ lb.

1-16.... 4

When the keeper was in contact with this magnet, reversion of the poles was not effected. The reversing apparatus used was that exhibited to the Section last* year.

Magnet No. 4, same size, &c. except that the ground dises at the poles were replaced by pins, for the purpose of retaining the wire. Coiled with 500 feet No. 12 iron wire, in 5 equal helices, same battery, charge, &., hardly any magnetic effect, although Magnet No. 2 of this series, when connected at the *same* time with the battery, was powerfully excited fig.

Magnet No. 1, same battery &c. Flannel cases of zinc plates had now been used several times,

at 1-16 inch.......... lifted.. 2½ lb.

Magnet No. 2, again at ⅛ inch.... 5½

1-16 .. ..14½

I had frequently remarked an electro-magnet to improve by use.

FIFTH SERIES.

Magnet No. 1, soft iron square horse-shoe bar, interior length 5.15-16, exterior 7¾ inches, ½ inch square, coiled with one helix of 90 feet No. 13 copper wire.

Magnet No. 2, *cast iron*, same size, similar helix.

Magnet No. 3, wrought iron, same length, but round bar, ⅝ diameter; coiled with a similar helix in two lengths, each coiled over the entire bar.

Magnet No. 4, same size, &c., coiled with 60 feet of same wire in two helices, one helix on each half of the bar, the coils increasing in number from the centre to the poles; battery 1 foot square, double cell, charge 300 drachms water, 6 sulphuric, 3 muriatic acid. This charge remained unchanged throughout this series. Keeper No. 1, 5¾ inches long, ⅞ wide, ½ thick, weight 12½ oz. Keeper No. 2, same length, double thickness, weight 18½ oz.; there was, of course, but one ring to the larger as to the smaller keeper, which

* See plate iv. fig 3.

accounts for the former not being double the weight of the latter.

		lb.	oz.
Magnet No. 1. with keeper	No. 1		
		lb.	oz.
	lifted	25	3½
	2	8	11½
	3	·39	3½
	4	39	3½
	3	25	3¼
	2	7	3
	1	30	2½

Magnet No. 1, with keeper No. 2, lifted 32.11; an accidental stirring of the battery accounts for the increase.

		lb.	oz.
Magnet No. 4, with keeper No.	1, lifted	84	3½
	2	26	3
	1	24	2½
	2	15	3½

Sixth Series.

To test, with as much accuracy as possible, the comparative excellence of various charges, he tried the following experiments. The galvanometer consisted of small, but exceedingly good, electro-magnet M, a * battery, B, two inches square, single cell, zinc plate ⅛ inch thick at commencement of experiments, and a delicate needle, N, made to stand at zero when the battery was not connected with the magnet. The least magnetism produced by connecting the battery with the magnet, tended to deflect the needle. He preferred this galvanometer, on this occasion, to the ordinary one, for many reasons. The battery was well cleaned after each charge. The first deflection on connecting the battery with the magnet, carefully noted the number of degrees at which the needle rested, and the decrease of deflection every quarter of an hour for six quarters. Rain-water was used. The specific gravity of the sulphuric acid 1840; nitric acid 1410; muriatic 1175.

The solution of caustic potash contained 2 in 7½ of the liquor.

* See plate iv fig 4.

TABLE OF RESULTS OF THE EXPERIMENTS.

	First Deflection.	Needle settled down to	Deflection in 1st quarter decreased to.	In 2nd quarter.	3rd.	4th.	5th.	6th.
Rain water and nitric acid .. 1 in 21 parts	90°	52°	32¼°	16¼°	11½°	4¾°	3¾°	3°
1 in 31	38	27¾	15½	13	6½	5½	2½	2¼
1 in 41	46	46	31	14½	8½	3½	2½	¼
1 in 51	38	34 *	26½	12¾	7½	5	3	½
Rain water and sulphuric acid 1 in 21	88	44	15¼	13½	9½	8½	8¼	7
1 in 31	49	30¼	10	7¼	6¼	5	4	8½
1 in 41	67	44	15	8¾	5½	4½	4	2¼
1 in 51	33⅕	24	3½	2½	2	0	0	0
Rain water and muriatic acid 1 in 41	97	33½	7½	6¼	3	0	0	0
1 in 51	58	22½	9	6½	0	0	0	0
Solutions of caustic and potash	80	19	7¾	7	5½	4½	2¼	1¾
Rain water & sulph. acid 1 in 41½ nitric 1 in 83	98	48	24	11	7¼	6	5½	4¾
1 in 26½ .... 1 in 53	82	40	24	15½	9½	7½	6½	5½
1 in 161½ .... 1 in 323	23½	20½	7¼	4	1¾	½	0	0
1 in 201½ .... 1 in 403	50	23	2½	0	0	0	0	0
Rain water and muriat.. 1 in 52 sulph. 1 in 52	35	25	7½	6½	5¼	4½	4½	3¾
nitric 1 in 52	115	6[illegible]½	28½	18½	15½	10	0	0
1 in 52½ sulph. 1 in 105	85	46½	10	6	3½	0	0	0
Solution of caustic potash, and sulph. .. 1 in 51	88	45	8¼	1¾	4	0	0	0
and nitric .. 1 in 51	43	0 †	0	0	0	0	0	0
and muriat . 1 in 51	25	18	0	0	0	0	0	0
Sea water from Dublin Bay......	½	0	0	0	0	0	0	0
Sea water & sulphuric acid........... . 1 in 51	33	26	13	8	5¾	3¼	0	0
and nitric acid.............. 1 in 51	95	55	33½	15½	9½	0	0	0
Rain water and nitric, 1 in 53, sulph 1 in 53, and muriat. 1 in 53	95	59	40	16	10	3	0	0

* In two minutes it ran up to 85°, settled down to 51°.
† Would not deflect the needle even with renewed charge.

Mr. M'Gauley thought it would be unbecoming in him to suggest anything to the British Association; but he believed nothing would be more conducive to the interests of science, than that the Association should cause to be instituted a series of experiments on the Galvanic Battery and its Charge, which would set all questions on the matter at rest for ever. Before he left this part of the subject, he thought it well to recall the attention of the Section to the nature of the power obtained by electro-magnetism. In steam, one great cause of the varying power of the engine arises from the varying leverage of the crank. Let B and B' be positions of the extremity of the pistonrod, C' R and C' R' corresponding positions of the crank, the leverage of the crank is measured by the perpendicular C' P and C' P'. It varies as that perpendicular. But in electro-magnetism, the force at B, say the bar traversing between the magnets, is always varying. He would not then enter into some curious results obtained by calculation on this matter.*

He had been anxious to satisfy himself, by his own experiment, of the truth of the law of magnetic attraction being in the proportion of the inverse square of the distance, but abandoned the inquiry for the present, when he found that a magnet, with a seemingly appropriate bar, would lift at one-sixteenth of an inch only five pounds; though with a different bar it lifted the same weight at twelve times the distance; and that the greater the distance through which powerful attraction might be exerted, the less the lifting power appeared.

Identity of Magnetism and Electricity.—In examining the identity of electricities derived from different sources, it seemed to Mr. M'Gauley that we sometimes forget that electricity may be modified both as to quantity and intensity; and that if either be changed, or both, we cannot expect the same results. To test, therefore, the identity of any agent with electricity, we must not use those means which are the measure of, or dependent on, either quantity or intensity; for if in such experiments the electrometer or galvanometer be not affected, we only arrive at a negative conclusion—that if the agent under consideration be electricity, it differs from the ordinary electricity in quantity, intensity or both. For though we never had been able with galvanism to cause the leaves of the electrometer to diverge, or with machine electricity to deflect the galvanometer, or with electricity to produce magnetism, or with magnetism, electricity, with electricity to produce heat, with heat, electricity—their non-identity would by no means follow. To examine with ease and certainty the identity of anything with electricity, we must find some property of electricity, which is not modified by, nor dependent on, quantity or intensity. We know, and chemistry furnishes us with one proof, that the elements of things may be the same as to quantity, and as to the intensity of mutual action; and yet may be productive of vastly different effects. Thus we know, that from two equal volumes of carbon and hydrogen, may be formed at least three very different substances.

The following facts seem to afford additional evidence of the perfect identity of electricity and magnetism; and that magnetism does not require, nor suppose, the circulation of electrical currents.

1st. A shock and spark are obtained by means of an electro-magnet only after battery communication is broken; for no matter how long this communication is maintained, neither shock nor spark shall be perceived. 2ndly. The shock and spark are not the effects of the battery; for to obtain a shock—(this shock he had not seen remarked by any experimentalist)—it is not necessary to form a part of the communication between the *copper* and *zinc*, but merely between the extremities of the helix, or between either extremity of the helix and the copper *or* zinc of the battery. 3rdly. The shock and spark do not arise from the magnetism of the bar included in the helix, since the more perfectly the bar is demagnetized in breaking contact the better. Besides, it is curious that a powerful shock and brilliant spark may be obtained without any iron, and from a heap of wire thrown without any heliacal arrangement. This, Mr. M'Gauley remarked, would lead to a very simple and effective electrical apparatus, one easily managed, and always ready for use; the length and number of the coils, with a given calori-

* See plate iv. fig 5.

meter, has an effect on the shock and spark. Mr. M'Gauley exhibited to the Section wire coiled with the greatest accuracy, by a machine he had constructed, which was capable of covering any wire, manufacturing pianoforte strings, &c., in any length, without any care on the part of the operater, to the enormous extent, if necessary, of 7000 feet per hour. The wire which he exhibited, as several in the Section knew, was not more perfectly manufactured than the many thousand feet he had covered lately. He thought the shock and spark might arise in this way: a current of electricity passes through the wire from copper to zinc; its inductive action on the wire ceases suddenly, by the contact with the battery being interrupted; the disturbed equilibrium of the wire is suddenly restored. The electricity of the battery seems, in passing through the helix, to acquire an augmented intensity; but from these facts it is evidently not so. 4thly. The spark and shock appear to demonstrate that currents do not circulate around the magnet. If they do, as is evident, they are capable, as we know from secondary currents, of producing a spark and shock. The helix, of itself, is capable of these effects; let the helix and the magnet act conjointly; these effects ought to be doubled; the contrary is the fact; they may be annihilated, and they ought, for the magnet, by its electrical action, retains the helix in a state of excitation. The universal—at least in other cases—law of electrical induction, if applied to magnetic phenomena, easily explains them. He did not think it by any means certain, that electrical action consists in the *transmission of a fluid*, and not the mere arrangement of particles: this idea seemed opposed by an experiment he made some time ago. He never could believe that the action of the galvanic battery consisted in the passage of electricity through the fluid from zinc to copper, and along the connecting wire from copper to zinc; he thought that the repulsion which sent the electricity through the fluid—an imperfect conductor—ought to prevent its return along the wire. He constructed a small box of wood, being a cube internally of three inches, divided it into twelve water-proof cells by well-cemented glass plates; placed in the cells six copper and six zinc plates, one in each, in the usual galvanic order; filled the cells with a charge of 1 in 59 sulphuric acid, 1 in 100 nitric acid, and water, and connected the extreme plates with a delicate galvanometer, but no effect produced, except when the copper and zinc were in the same cell, or the cells were in conducting communication; but he did not deem this experiment conclusive against his idea, since, although induction might occur from particle to particle, through an imperfectly conducting fluid, it by no means follows this inductive influence should take place through the particles or glass, since the very insulating power of glass, or other substances, may arise from the incapacity of their particles for electrical arrangement.

If it be true, that electrical effect is the arrangement, and not the transmission, of particles, he thought we might easily understand the agitation of the muscles of a frog, caused in *breaking* contact with galvanic battery, even of a single circle; the dangerous effects to those in the neighbourhood of the discharge of lightning from cloud to cloud; and the spark and shock obtained from a quantity of wire—all of which probably arise from the same cause, and are the consequence of the same universal law.

Professor Ritchie rose to remark that without intending to convey the least censure on the gentleman, he could not but observe, that he had been so entirely occupied with his own researches as not to have intended to anything done by others, for there was really nothing new in this paper—and he gave examples.

Professor Stevelly remarked, that if the only objection to it were the crank and magnetic pendulum not working together, in a large machine that could be at once remedied, by what was well known in practical mechanics, a slipping coupling, as, when the steam-engine and water-wheels were made to work together, was generally done, or as in the winding part of the common clock. The great objection was the small distance through which the power worked, onesixteenth of an inch; thus, even if a magnet could be produced that would lift 1,000lb, would still render the numerical value of the horse-power almost evanescent compared with the steam-engine.

SECTION B.—CHEMISTRY AND MINERALOGY.

Mr. Exley's paper on the reduction of Chemistry to mathematical principles, was the first read. Mr. Exley commenced with a division of atoms, into what he denominated the *tenacious*, the *ethereal*, and the *electrical;* the first being distinguished by posessing the greatest, the last by enjoying the least *absolute* force, while in this particular the electrical occupied an intermediate position. In reference to these atoms, two propositions were then laid down, the first of which affirmed the atoms to attract each other according to the inverse square of the distance up to a particular point, when the attraction was converted into repulsion; the second, that dissimilar atoms differ in the relative energies of their attractive and repulsive forces, though these forces vary according to the same law. Mr. Exley having compared his views with those of Newton and Boscovich, and pointed out the particulars in which they differed, proceeded to state the grounds which led him to conclude that water was a ternary, not a binary compound; or, in other words, that sixteen, not eight, was the atomic weight of oxygen.

Having disposed of these preliminary topics, Mr. Exley entered upon the developement of his views in the form of a series of sixteen propositions. It is scarcely necessary to say, that this part of his paper does not admit of popular explanation; and it would be presumptuous in any individual to undertake the task, who was not deeply versed in the mathematical sciences, and who had not had the advantage, not only of perusing, but of studying the profound researches of Mr. Exley. We have, however, no hesitation in asserting that these researches are deserving of mature consideration. According to Newton, before a hypothesis is admitted, it must be proved *true*, and adequate to the explanation of phenomena. The former test is sometimes very difficult of application, and would be particularly so in the present instance. But, as respects the latter criterion, it must be admitted to pronounce in favour of Mr. Exley's theoretical postulates; for, by following *these* out, and applying to them mathematical reasoning, he is enabled to anticipate and explain a variety of the most important facts in chemistry and general physics. Thus, he deduces with facility from his principles the ordinary laws of chemical combination, Gay-Lussac's law of volumes, and even the variations of volume, which the gases are known to experience when submitted to various temperatures and pressures. But the most striking evidence of the truth of his theorems, adduced by Mr. Exley, remains to be mentioned. He has calculated by his abstract methods the specific gravities of fifty-seven substances, supposed in the gaseous state, (some, such as alcohol, oil of turpentine and camphor, being compounds of an extremely complex nature,) and found the results to correspond as closely as could in such investigations be expected, with those obtained by direct experimental means. Doctors Dalton and Thomson of Glasgow, as well as other competent judges, bore testimony to the ingenuity and talent shown in Mr. Exley's paper.

Mr. Babbage next exhibited a thermometer, recently discovered in Italy, and supposed to be one of those originally manufactured for the Societa del Cimento. It appeared to be filled with alcohol. The bulb was spherical, and the stem was divided into fifty equal parts by beads attached to it by fusion at equal distances. These instruments, as is well known, being graduated without reference to fixed points, do not give indications comparable with those of the modern thermometer. Libri, it is generally understood, and the circumstance was stated by Professor Babbage, has attempted the interpretation of the scale of these instruments, partly by a comparison with each other of ancient and modern meteorological registers, and partly by taking with them the temperatures of certain tepid waters in the Pyrennees, which had been previously examined by the Florentine Academicians. Dr. Daubeny observed upon the inaccuracy of the latter method, as that springs undoubtedly undergo, in process of time very considerable changes of temperature.

An essay on Gaseous Interference, by Dr. Charles Henry, was next read. —It is universally known to chemists, that if oxygen and hydrogen be mixed, and brought into contact with metallic platinum in the state of wire or foil, or

more especially in the spongy form, the combination of these gases is very rapidly achieved, and, if mixed in the proportion, they are converted, usually with the phenomena of ignition, altogether into water. It is also well known and was first noticed by Dr. Turner, that if into an atmosphere of oxygen and hydrogen, mixed in the ratio necessary for forming water, certain other inflammable gases, such as carbonic oxide and olefiant gas be introduced, the combination of the oxygen and hydrogen is, if not altogether suspended, at least materially interrupted. This is what Dr. Henry denominates *gaseous interference.* The cause of this remarkable effect has, at different times, attracted the attention of eminent chemists. Dr. Turner has ascribed it to the soiling of the platinum by the interferings, Dr. Faraday to some peculiar condition induced in the metal; while Dr. Henry himself, at a period long prior to the present, conceived it to arise from the fact of carbonic oxide and olefiant gas, having a stronger affinity than hydrogen for oxygen gas. In his present paper, Dr. Henry investigated the entire question. The prominent facts and inferences appeared to be that carbonic oxide retards and limits, but does not altogether prevent the action of platinum on the usual explosive mixture, and the same may be said of olefiant gas. The *interfering* power, however, of the former is vastly greater than that of the latter, their ratio being represented by the numbers 18 and 1. In the case of carbonic oxide, carbonic acid is always produced, the amount depending on the form of the platinum employed, the quantity of the interfering gas, and the temperature at which the experiment is conducted; and, as a general rule, it may be laid down, that the interfering influence of the gas bears an inverse relation to the energy with which the platinum acts, and the degree of heat—conditions, however, which may be considered as identical. The diminution, and even disappearance, of interference at high temperatures, Dr. Henry attributes to a relative augmentation of the affinity of hydrogen for oxygen, an hypothesis indeed established by othery and independent facts.

That Dr. Henry's theory of gaseous interference is the true one he infers from the general fact of no gases exercising any such influence but those which have an affinity for oxygen; and that it is strictly true, at least in the case of carbonic oxide there can be no question, seeing that some of the oxygen is actually employed in the production of carbonic acid.—Dr. Turner expressed his conviction of the value of Dr. Henry's paper, of the ability with which it was drawn up, and of the correctness of the solution of the problem of interference, and such appeared to be the prevailing opinion.—In the course of the paper several other interesting facts, of a collateral description, were stated, and, amongst others, that platinum causes, though slowly, the combination of a mixture of oxygen and carbonic oxide, but that the process is facilitated by the introduction into the jar of a little caustic potash. This latter circumstance he attributed to the removal of the carbonic acid by the potash as fast as it was produced, but Dr. Daubeny, with much probability, viewed it as a case of disposing affinity.

Mr. Herapath then read a paper on Arsenical Poisons, and drew the attention of the Section to the case of Mrs. Burdock,, in which he he was professionally employed, and which proved to be one of Realgar. While engaged in chemical investigations connected with this case, he ascertained that Realgar is convertible into orpiment by hydrosulphuric acid, and the soluble hydrosulphates, and that it undergoes, as might have been anticipated, an analogous change in animal bodies submitted to putrefaction. Mr. Herepath also stated, if we understood him rightly, that Realgar favours the conversion of animal matters into adipocire, a fact, undoubtedly of a very novel description, and one not very reconcileable with those researches of Chevreul and Gay-Lussac, which have demonstrated this fatty substance to be an ammoniacal soap. This gentleman concluded by exhibiting some experiments illustrative of his methods of toxicological investigation.

Section C.—GEOLOGY AND GEOGRAPHY.

Dr. Buckland in the chair.—The first paper was. A Classification of the old Slata Rocks of Devonshire, and on the true position of the Culm deposits of the central portion of that country,' by

Professor Sedgwick and Mr. Muchison.—The authors began by observing that this was a mere outline of a more detailed memoir on the physical structure of Devonshire, which they were about to lay before the Geological Society of London. In the published geological maps of that country, the whole system of the older slate rocks was represented under one colour, without any attempt at subdivision; and one colour also represented different limestones, without any discrimination. The object of the authors was, to remedy these defects,—to ascertain and represent the true position of the successive deposits and their natural subdivisions, so as to compare them with corresponding deposits in other places. They also wished to determine the true place of the remarkable carbonaceous deposits of central Devon, which had been previously regarded as belonging to the lowest portion of the grauwacke formation. A section was exhibited of part of that country, from the north coast to one of the granite peaks of Dartmoor immediately south-west of Oakhampton.

[*The following is a description of the Diagram which will be found to art fig.* 7.]

ASCENDING SERIES OF DEVONIAN ROCKS.

Cambrian Rocks.	(*a*) Slaty schists, with some calcareous courses and organic remains.
	(*b*) Purple, red, and grey-sandstones, with beds of iron ore in upper members---peculiar fossils near their junction with the overlying limestones. Veins of lead and copper.
Upper Cambrian	(*c*) Calcareous group of Combe Martin & Ilfracombe—fossils very abundant—slatey cleavage.
or Devonian Rocks.	(*d*) Slates with quartzose veins and beds—incoherent schists, &c. Manganeset mines.
Silurian Rocks.	(*e*) Slaty sandstones and schists-cleavage passing thro' the beds of organic remains.
	(*f*) Ditto, with concretionary limestones, and many well-known Silurian fossils, chiefly of the lower part of the system.
Culm Deposits =Coal-field of	(*g*) Culmiferous or black lime-stone, with portions of stone coal, and fossils distinct from any found in the inferior groups-Wavellite occurs in the beds below this lime-stone.
Pembroke.	(*h*) Culm beds with underlying and overlying successions of sandstone and shale often highly pyritous, with many nodules of iron ore, frequently containing coal plants, and never affected like the older rocks by slaty cleavage.
	(*i*) New red sandstone resting unconformably on the carbonaceous deposits.
	(*k*) Granite of Dartmoor and Elvan Dyke, both erupted through the culm deposits.

In the ascending order this section exhibits—

1. A system of slaty rocks, containing a vast abundance of organic remains, generally in the form of casts. These rocks sometimes pass into a fine glossy clay slate, with a true transverse cleavage; sometimes into a hard quartzose flagstone, not unusually of a reddish tinge; sometimes into a reddish sandstone, subordinate to which are beds of incoherent shale. In North Devon they are very rarely so calcareous as to be burnt for lime, but in South Devon, rocks of the same age appear to be much more calcareous.

2. A Series of rocks characterized by masses of hard thick-bedded red sandstone, and red mecaceous flagstone, subordinate to which are bands of red, purple, and variegated shades. The red colour occasionally disappears, and the formation puts on the ordinary appearance of a coarse, silicious grauwacke, subordinate to which are some bands of imperfect roofing slate. In this series are very few organic remains. It is several feet in thickness, occupying the whole coast from the west end of the Valley of Rocks to Combe Martin.

3. The calcareous slates of Combe Martin and Ilfracombe, of very great aggregate thickness, abounding in organic remains, and containing in a part of their range at least nine distinct ribs of limestone burnt for use. This limestone is prolonged into Somersetshire, and appears to be the equivalent of that on the flanks of Quantock Hills.

4. A formation of greenish and lead-coloured roofing slate of great thickness, and occupying a well-defined zone in North Devon, its upper bed alternating with and gradually passing into a great deposit of sandstones of various colours and mycaceous flagstones. These silicious masses alternate with incoherent slates, and are in some places surmounted by great masses of red unctuous

shale, which, when in a more solid form, generally exhibit cleavage oblique to the stratification.

5. The Silurian system resting conformably on the preceding, and of great thickness, on the north-western coast, containing many subordinate beds and masses of limestone. In its range towards the eastern part of the county it gradually thins off, but its characters are well preserved, and it everywhere contains vast numbers of characteristic organic remains.

6. The carbonaceous system of Devonshire, in a direction east and west across the county, in its southern boundary so close to Dartmoor that its lower beds have been tilted up and altered by the granite. It occupies a trough, the northern border of which rests, partly in a conformable position upon the Silurian system, and partly upon olderrocks, probably of the division No. 4. Its southern border also rests on the slate rocks of Launceston. It everywhere exhibits a succession of violent contortions. In some places it is overlaid by patches of green sand, and west of Bideford by conglomerates of the new red sandstone. The lowest portion of this vast deposit is generally thin bedded, sometimes composed of sandstone and shale, with impression of plants, sometimes of indurated compact slate, containing wavellite. These beds are surmounted by alternations of shale and dark-coloured limestone with a few fossils. Subordinate to these, there are on the western side of the county thin veins and flakes of culm or anthracite; but this is wanting on the eastern side, and the calcareous beds are more expended. The higher beds of this deposit are well exhibited on the coast west of Bideford. These often contain impressions of vegetables. Though in a state of greater induration than the ordinary coal-measures of England, and even in many places destitute of of any trace of coal, still these beds do not differ from the great unproductive coal-field of Pembrokeshire. They consequently concluded, that from the order of superposition.—from mineral structure—from absence of slaty cleavage peculiar to the older rocks on which this deposit rests, and from the specific character of its organic remains, it may without hesitation be referred to to the regular carboniferous series.

In the course of the details, the authors alluded to a remarkable elevated beach, occupying two miles of coast on the north side of Barnstaple Bay, a more special account of which is being prepared for the Geological Society.

Mr. De la Beche objected to the conclusions of Messrs. Sedgwick and murchison, although he did not dispute the correctness of the section of the country which they had exhibited to the meeting. He conceived that he had traced the carbonaceous rocks passing into what had been termed the Cambrian system, although he was not prepared to say that it really was that system. He was also unable to make that separation of the contorted rock, suggested by the authors of the paper. He spoke of the overlying greenstones in different places, and considered that those were of different ages; also of the changes produced by granite on rocks of every kind in contact with it. He alluded to the former opinions of the rocks called by the general name, Greywacke, which opinions have, of late years, been totally altered. He attached very little importance to mineral characters; unless the consideration of the imbedded organic remains was made of the first importance, we were sure of falling into error. Are the organic remains in these carbonaceous rocks of Devon really the same as those of the general carboniferous system? He stated, that he conceived there was evidence to prove that there was a regular band of rocks surrounding Dartmoor, which had been thrust up through the hollow in the middle. He could nowhere discover any line of separation between the carbonaceous and the older rocks, so that he was unable to reconcile the deposits of coal with those of other parts of England, and with the age of these older rocks all were agreed. In the Alps, organic remains of the coal formation are found in beds, alternating with oolites, so that we must not limit too strickly the range of these organic remains as we should be certain of all the conditions under which coal plants can be accumulated. We should recollect, that the remains of the vegetation of a mountain may be entombed at its base, so as to be shifted from its original habitat; and that, although the disposition of organic remains may hold true for a certain extent of the earth's surface, we have no

right to consider such a disposition universal—Mr. Sedgwick remarked, that he could with certainty distinguish four calcareous strata in North Devon—viz. one at Linton, a second at Ilfracombe, and two others at Barnstaple. The difference of the limestones of South Devon was also very remarkable; that of Plymouth being essentially distinct from that of Dartmoor. These carbonaceous strata also extended several miles into Cornwall.—Mr. Conybeare considered that the public had exaggerated the difference of opinion then before the meeting. He was rather inclined to coincide with Messrs. Sedgwick and Murchison in considering the strata in dispute as referable to the general carboniferous system, and from the general resemblance of the formations of those of Pembrokeshire, the probability was much strengthened.—Professor Phillips conceived that it had been satisfactorily proved, that there existed a coal basin in the interior of Devonshire, although, at first sight, from the unprofitable nature of the contained coal, being the kind called Culm, some hesitation might have taken place as to assigning it its true position. But doubts must vanish on inspecting the organic remains: and here he might observe, that it was a mistake to suppose that Dr. Smith, the founder of English Geology, had ever intended to limit the range of these remains as some had accused him of. We might readily assume, and observation has confirmed, that some organic remains of one stratum may be found in contiguous strata, associated with fossils of different kinds, so that organic remains alone are insufficient to point out distinctions in strata. But, the general appearance of the limestones of Devon was precisely similar to those of the north of England, in regard both to mineral character and imbedded fossils. From their appearance, he had expected their interstratification with shales, and Mr. Murchison had confirmed this supposition. The Devon limestone corresponded indeed with the upper bed of the Yorkshire limestone; in the former he had detected a shell, a species of Anodon, which he had not observed in the latter: but the species of Posidonia found in both exactly correspond. Perhaps one cause of mistake might have been the little attention paid to the black limestone of Craven, by Mr. Conybeare, and to this limestone there was a most striking resemblance in the black variety of Devonshire. He alluded to the extraordinary anomaly of coal plants having been found in the Alps, associated with oolites, but this might be an exception from the general law, and exceptions there must be; still it must be allowed, that organic life must have a constant relation to the state of the actual surface. He came to the conclusion, that the Devon district would not offer any anomaly in geological arrangement, but that it would correspond in arrangement with the other parts of the country, and that a fruitful source of error is the hitherto vague term Greywacke, which has been applied indiscriminately to a great variety of rocks, so as to include many of different ages throughout this country.—Dr. Buckland congratulated the meeting on the difference of opinion among the geologists present, such a difference producing discussion, which was the sure means of arriving at truth. He considered, that the true solution of the question at issue would be in the middle course; that, no doubt, it could not be easily granted, that the series under consideration was carboniferous, when no true coal was contained in it; but, were we to adopt the new term *culmiferous*, we should get rid of the difficuty. This culmiferous series he regarded as the lowest portion of the coal formation, and as resting upon the Silurian rocks. He alluded to the difficulty of making geological maps; these must be constantly modified, according to extent of investigation: errors of omission must be committed by every pioneer in Geology, which can only be corrected by the researches of succeeding observers.

After the discussion was closed, Mr. De la Beche rose to submit some considerations on the connexion of the Geological Phenomena of Cornwall and Devon with the Mineral Veins of those counties. He commenced with defining the local Cornish terms of *lode*, *cross course*, *counter*, and *elvan*, the first three referring to veins of metallic, the latter to a vein of granitic matter. A number of these had been laid down in his geological map of Cornwall with the most perfect mathematical accuracy. He next mentioned the overlying masses of greenstone, which are of different age, and in

some are imbedded portions of the slate rocks. Granite must have been protruded last of all the rocks, as it cuts off the greenstone in many places ; but the phenomena of the veins are still more singular, as first the elvans, and then the lodes, cut through everything. He referred to certain faults in the greenstand district of Blackdown, and, most singular to relate, these faults exactly corresponded in direction with those of Cornwall, although the latter were highly metalliferous veins, while the former were fissures destitute of any valuable content. He therefore laid out the conditions of a profitable metalliferous vein, as deduced from the experience of practical miners, that it should be near the granite, and that the best signs were an elvan and a cross course. In the parish of St. Just these phenomena are in the highest degree remarkable ; and, near Penzance, where the elvan courses are traversed, metals are sure to occur. The lodes of slate rocks are generally unproductive. Mr. De la Beche was particularly anxious to impress these facts on the public in general, as mining speculations had been of late so much the rage, that the more theoretical knowledge that could be diffused the better, so as to cause inquiry to be made respecting the geology of the mining district about to be entered upon by a joint stock company, before capital was invested in a hazardous, and perhaps ruinous enterprise.

Mr. Hopkins was called upon to make some observations regarding the direction of the fissures mentioned by Mr. De la Beche, but he did not enter very fully into any discussion, as he proposed, on the following day, to bring the general consideration of fissures before the Section. He observed, however, that there must have been one great axis of disturbance, to which the smaller fissures must either have been parallel, or have circulated around it—indeed, Mr. De la Beche had supposed the great line of fissures from Blackdown to Cornwall had been curved by the intervening granites. He stated, that there must be a connexion between the width of lodes and their mineral contents—also, that in the production of fissures there must have been several periods of elevation.

Mr. Fox then mentioned a remarkable experiment which he had made upon the yellow sulphuret of copper, having changed it by electricity into the grey sulphuret. In a trough a mass of clay was placed, so as to divide it into two portions, in one of which was sulphate of copper in solution, in the other dilute sulphuric acid. On the electric communication being made by placing the yellow sulphuret in the solution, and a piece of zinc in the acid, the change of sulphuret took place, and crystals of native copper were also formed upon it.—Mr. Taylor bore testimony to the importance of geological information to mining agents, who now were informing themselves, not only in practice, but in theory. He spoke of the exertions of the late Mr. Phillips in drawing up a geological map of Cornwall, so far back as 1800. He suggested the propriety of tracing the lines of fissures into the coal districts, and also wished the directions of the lead lodes of the mountain limestone to be ascertained, as likely to lead to general results.—Messrs. Conybeare and Sedgwick made some observations on the importance of making use in Geology of such an agent as Electro-Magnetism.

SECTION D.—ZOOLOGY AND BOTANY.

Professor Henslow in the chair.—Dr. Richardson resumed the reading of his Report on the Zoology of North America. In touching upon the geographical distribution of the mammalia, he remarked the great similarity which existed between them and the European species ; whilst there was the greatest dissimilarity to those of South America. The boundary line separating the Fanas of North and South America, was not at the Isthmus of Darien, but at the tropic of Cancer. No Quadrumana occur to the north of the Isthmus of Darien ; though in Europe there is a species which ranges as far north as the rock of Gibraltar, in latitude 36°.

In the order Carnivora, and family Cheiroptera, all the North American species belong to that tribe which possesses only one bony phalanx in the index, and two in each of the other finger, to which tribe also all the European bats belong, except an Italian speices of Dinops. None of the sixteen speceis recorded as natives of North America have been found elsewhere; two only have been traced over any great extent of country, and one of

these (resembling the European Pipistrellus) ranges through 24° of latitude, and is the most northerly species in America. There must be still many bats to be discovered in that country, as those of Mexico, California, and the whole tract of the Rocky Mountains are entirely unknown.

Of the family Insectvora, ten species were enumerated; and it was stated that North America differs more from Europe in this family, than in any other of the order Carnivora. Three of the European genera do not exist in North America, and the three genera found in North America do not exist in South America. The North American species of Sorex, however, closely resembles those of Europe.

Of the family Marsupiata, inhabiting the New World, only three species reach into North America, the rest being confined to the south of the Isthmus of Darien. Two of these occur no higher than Mexico; but the third (the Verginian oppossum) range to the great Canadian lakes on the north, and to Paraguay on the south.

About forty species of the family Carnivora have been noticed; and this family includes a greater number than any other which are common to both North America and Europe; though possibly a closer acquaintance with some which are at present considered identical, may enable us to discriminate between them. The generic forms of North America are the same as those of Europe, excepting in a very few cases, which belong to the South American group. A few of the more northern forms also cross the Isthmus of Darien to the south.

In the family Plantigrada, two, of the four bears of North America, are undoubtedly peculiar to the New World; and one of these, is the most northerly quadruped it contains. The American Glutton, or Woverine, according to Cuvier, is identical with that of the Old World. Among the Digitigrada, the range of the Mustelæ is limited southwards, to the northern or middle districts of the United States. Whether any of the American and European species of this genus be really identical, is involved in great uncertainty. Of the three Otters of north America, one appears to be identical with that of Europe; and another, if correctly identified as the *Lutra Brasiliensis*, has a most extensive range, from the Arctic Sea through great part of South America.—Eight species of the genus Canis are found in North America; but there is great difficulty in distinguishing the species, and in indentifying them with any of those of Europe. The domestic dog breeds with the wolf and fox, and their offspring is prolific.

Eight species of the genus Felis were mentioned by Dr. Richardson, three of which, extend from South America into the south western territories of the United States, and some of the others are still doubtful as North American species.

The nine species of Amphibia found in North America, are mostly common to the northern seas of the Old and New Worlds: the genus Otaria alone being confined to the North Pacific; and even these range to the Asiatic coast. The specific identity of some of the seals is involved in very great doubt.

In the order Rodentia, there have been between seventy and eighty species discovered; and here North America surpasses every quarter of the globe in the abundance and variety of form which these animals assume. The squirrels are not yet satisfactorily determined. The marmots are numerous excepting in the sub-genius Spermophilus. There is only one which may possibly be common to the New and Old World. There is only one of the restricted genus Mus, which is unequivocally indigenous to North America; and these closely resemble the European *M. sylvestris*. Other species have been introduced from the opposite side of the Atlantic.

Mr. Bowman read a communication respecting the Longevity of the Yew-Tree; and mentioned the result of his observations upon the growth of several young trees, by which it appeared, that their diameters increased, during the first 120 years, at the rate of at least 2 lines, or the one-sixth of an inch per annum; and that under favourable circumstances the growth was still more rapid. In the church yard at Gresford, near Wrexham, North Wales, are eighteen yew-trees, which are stated by the parish register for 1726 to have been planted in that year. The average of the diameters of these trees is 20 inches.

Mr. Bowman then remarked on two yew-trees of large dimensions, from the trunks of which he had obtained sections. One is in the same churchyard as those above mentioned, and its trunk is 22 feet in circumference at the base, 29 feet below the first branches. This gives us a mean diameter of 1,224 lines, which, according to De Candolle's rule for estimating the age of the yew, ought also to indicate the number of years. From three sections obtained from this tree, Mr. Bowman ascertained that the average number of rings deposited for one inch in depth of its latest growth, was 34-23. Comparing this with the data obtained from the eighteen young trees, he estimated the probable age of this tree at 1,419 years. The second of these trees is in the churchyard of Darley in the Dale, Derbyshire, and its mean diameter, taken from measurements at four different places, is 1,356 lines. Horizontal sections from its north and south sides, gave an average for its latest increase, at 44 rings per inch nearly, which gives 2,006 years as its age, by the mode of calculation adopted by Mr. Bowman. He then proceeded to state his opinion of the reasons why so many old yew-trees were to be met with in churchyards: he considered that might have been planted there at a period anterior to the introduction of Christianity, under the influence of the same feelings as those, which prompted the early nations of antiquity, to plant the cypress round the graves of their deceased friends.

Mr. Ball exhibited the skulls of a species of seal common in Ireland, with the view of eliciting information, as he considered it to be new to the British Fauna, and very distinct from the two already recorded. The present species was never known to become tame, whilst the *Phoca vitulina*, generally considered the more common species of our coasts, was very easily tamed — Prof. Nilsson, of Leind, at once pronounced this species to be his *Haliochœrus griseus*, forming a distinct genus from *Phoca*, and described by him in the year 1820. It had been previously recorded by Fabricius, under the name of *Phoca gryphus*. It is common in the Baltic and North Sea, and to be met with in Iceland, and attained to a size of eight feet in length. In Sweden it was emphatically termed the Sea-seal, in contradistinction to those which inhabited gulfs. He remarked that the name of *Phoca vitulina* had been applied by Linnæus, and subsequent authors, to three distinct species, to which he had himself given the names of *barbata*, *variegata*, and *annellata*. Of these he had ascertained that a specimen, captured in the Severn, and now in the Bristol Institution, belonged to the *annellata*.—Dr. Scouler remarked that the species which Prof. Nilsson had identified as his *Haliochœrus griseus*, predominated in Ireland over the *Phocha vitulina*, though it had been hitherto neglected ; and that the great difference in the teeth of these species justly entitled them to be considered as forming distinct genera.—Dr. Riley exhibited the stomach of the specimen alluded to, as having been captured in the Severn, in which he had found from thirty to forty pebbles, and states that other instances had occured of a similar nature ; and that it was a popular notion, that they assisted the seal in the way of ballast whilst catching his prey, which he did by rising vertically upwards, and seizing it from below. But Sir Francis Mackenzie then asserted, that he had repeatedly seen the seal chase salmon into the nets, and that it was not usual for it to capture its prey in the way described. Neither he, nor Professor Nilsson, nor Mr. Ball, had ever found stones in the stomach of this animal.

Dr. Hancock read a paper on a new species of Norantea, from Guiana, termed by the natives Corocoromibi. This grows on the banks of rivers, and in moist places, and its botanical characters closely resembling those of the *Norantea Guianensis*; he had long confounded it with that species. As Aublet's plant is, however, described as a tree which grows eighty feet in height, and as the present species is a large climber they must be distinct ; and Dr. Hancock then detailed the botanical characters of the latter.

Mr. Hope exhibited a remarkable specimen of the *Lucanus Camelus*, Fabr. from North America, the right side of which had the configuration of the male, and the left of the female sex. This monstrosity was analogous to one which had been observed in the *lucanus cervus*, a closely allied species of Europe. The exhibition of this specimen led to a discussion, in which Mr. Cuttis

Dr. Riley and Mr. Yarrell took part concerning those principles of development, by which monstrosities of the above description were reducible to the operation of general laws. Mr. Yarrell particularly noticed the occurrence of both male and female organs, on opposite sides of various hermaphrodites, in lobsters, and birds, which he had dissected, and stated that he had met with an instance of a fish, which had a hard roe on one side, and a soft one on the other. He had met with a very extraordinary example of double sex in a fowl, which he had not yet made public and of which he now detailed some of the more interesting particulars.

Mr. Hope read a communication, expressive of the probability that some of the early notions of antiquity were derived from the observation of insects. In attempting to account for the apparently spontaneous generation of those insects, which rise in myriads from the mud left by the waters of the Nile, the philosophers of antiquity turned their earliest attention to the operation of the external influence of the elements, and Mr. Hope, supporting his opinion by numerous quotations, showed that they considered the sun as the chief and efficacious power in producing this effect. The opinion of spontaneous generation was universally adopted, and in full force till the middle of the sixteenth century, and is still retained in the greater part of Asia and Africa, and even held by certain eminent naturalists in Europe. The origin of the doctrine of a metempsychosis, he considered, might be deduced from their actual observation of the metamorphosis of certain insects. This doctrine is now confined to the Gawrs of Persia, and some other idolatrous nations of the Asiatic continent.

Mr. P. Duncan offered a few remarks upon the subject of Mr. Hope's speculations.

M. G. Webb Hall commented on the effects of lime as variously applied to different soils, and considered the general effects of this substance, with respect to its value as calcareous earth, and its septic qualities as facilitating the decay of vegetable matter. In the latter capacity it was found to be most beneficial in a humid climate like that of Devonshire. He pointed to the necessity of a scientific inquiry for the purpose of obtaining more precise information than we yet possessed, as to the requisite proportions in which lime should be furnished to land of different qualities. He had found that less was required, and a greater benefit produced by employing lime fresh from the kiln, and ploughing it, into the ground within twelve hours of its being laid on the surface. He bore testimony to the value of gypsum as a manure for lucerne. Mr. Rootsey was sceptical as to the ill effects so universally attributed to magnesian limestone, and which had been alluded to by Mr. Hall, as he knew an instance where very large crops were obtained from a district, where this rock prevailed.

Section E.—ANATOMY AND MEDICINE.

Dr. Roget in the chair—The first paper read was entitled, 'Observations on Remedies for Diseases of the Brain,' by Dr. Prichard, of Bristol.—Dr. Prichard remarked, that perhaps all curative attempts in cases of disease affecting the brain resolve themselves into the modifications which medical art is capable of effecting in the vascular state, of parts within the skull. We can promote by various means either fulness or inanition of the blood-vessels in the brain: whether anything beyond this is in our power, is very uncertain. Besides general and local bleeding, all those means belong to the same class, which act by refrigerating or heating the surfaces either of the head or of other parts. Refrigerant applications to the head have the effect of contracting the calibre of the arteries, and thereby diminishing the quantity of their contents. Pediluvia, or other means of applying warmth to the lower extremities, produce a similar result by augmenting the capacity of vessels remote from the head, and causing a greater quantity of blood to be determined into them. All these means plainly owe their efficacy to the modification which they bring about in the state of the vascular system of the brain. The only class of remedies respecting the *modus operandi* of which any question can be raised, are those which produce what is termed counter-irritation; and perhaps the doubt which exists in this instance arises from the obscurity of the subject. It is very generally supposed, and perhaps cor-

rectly—at least it is very difficult to find any other hypothesis on the subject that is more probable—that the means of counter-irritation, such as rubefacients, vesicatories, and issues, produce their effect by lessening an hypoplethoric state of the vessels in internal parts, and that they bring this to pass by increasing the fulness of the vessels in surfaces to which they are immediately applied. There are facts which it is very difficult to reduce under this sort of explanation; as, for example, the relief obtained in cases of pneumonia or of bronchitis, by means of blisters applied to the parity of the chest, there being in these instances no continuity of structure that might render the proposed explanation in some degree intelligible. On the other hand, there is little doubt that such remedies are most efficacious when they are applied over surfaces nearly juxta-position with the seat of disease; and this fact, if not called in question, goes far towards establishing the notion before alluded to as to their mode of operation.

A case has lately occurred in my practice at the Bristol Infirmary, which strongly exemplifies the efficacy of the treatment which I have recommended, and which I have fortunately an opportunity of bringing before the Medical Section in the most convincing way. A youth, aged about eighteen, came into the Infirmary, labouring under complete amaurosis, which had been coming on gradually for a week or ten days before his admission. At that time it had become so complete, that vision was entirely lost, and the pupils were totally insensible to light even when the rays of the sun were suffered to fall immediately into the open eyes. At first he was freely and repeatedly bled from the arm and temporal artery, had leeches applied to the scalp, blisters to the nape of the neck, and took calomel so as to render his gums sore. Finding that no effect whatever was produced by these measures, I gave up the expectation which I had at first entertained of his recovering sight, but was resolved to give the remedies a complete trial. I ordered him to be bled *ad deliquium*. This took place after a small quantity of blood had flowed from his arm while he was in an erect posture. After a few days (he was still perfectly dark) an incision was made over the sagittal suture from the forehead to the occiput. It was filled with peas. In three or four days, precisely at the time when suppuration began to take place, the patient declared that he perceived light, but was scarcely believed, since the pupils were still widely dilated and quite insensible to a strong light. In the course of a few days it was quite evident that he saw—he could tell when two or three fingers were held up. For some weeks the iris was still quite irritable, though vision had become in a great degree restored.

The subsequent treatment of the case consisted chiefly in occasional leechings, purging, and low diet. When the issue healed, which was not till it had been kept open for some months, a seton in the neck was substituted; under this treatment the case has terminated in a complete recovery of the blessings of sight.

Dr. O'Beirne stated, that treatment was perfectly new to him, and he should feel himself amply compensated if he derived no other benefit than hearing this paper from his attendance at the British Association.—Dr. Carson stated, rather as an objection, that if an animal were bled to death, the same quantity of blood would be found in the cranium, and that the doctrine of determination of blood to the head was unfounded, and frequently led to great errors in practice.

The second paper read was by Dr. Houston, on a human fœtus without heart or lungs. Several drawings were exhibited, and the reading of the paper led to a short discussion, in which Drs. Prichard, Carson, O'Beirne, Macartney, and Mr. Carmichael, took part.

The third paper was by R. Carmichael, Esq., on Tubercles.—M. Carmichael commenced with some remarks on the great prevalence of these formations, and then proceeded to detail their appearances according to Laennec and Carswell. He adverted to the use of term Scrofula, which he considered a cloak for ignorance; and, having stated that Drs. Todd, Clark, and Carswell, believe in the identity of Scrofula and Tubercle, disputed this position, and likewise their opinion, that tubercles are inorganizable deposits. Among other objections he urged the inconsistency of representing enlarged cervical glands and pulmonary tubercles as identical, since it is well

known that former may be injected, but not the latter; & of maintaining the non-inflammatory origin of tubercles, together with the view that these bodies are lifeless matter; since, if such is their nature, they must excite inflammation in the tissues which contain them. He allowed, however that the scrofulous constitution disposes to tubercles, but only in the same manner as to cancer.

Mr. Carmichael next adverted to the generally-re-cognized connexion between Scrofula and disordered digestion, and claimed the priority of this observation by reference to a work which he published in 1810. He then proceeded to argue, at considerable length, in favour of the parasitical origin of tubercles, pointed out the absence of vascular communication between these bodies and surrounding parts, and observed, so long as the former retained their vitality, no inflammation takes place. The author declared his opinion, that Carcinoma must likewise be arranged among the Entozoa; and, having indicated the division of a cancerous formation into a medullary cartilaginous portion, assigned to the former an independent vitality, the latter being only a barrier which nature sets up against the parasite, and observed, that the containing cyst belongs to the surrounding tissue. The cartilaginous portion he stated might be injected, but not so the medullary tubercles, which he considered more allied to Carcinoma than to Scrofula. Having spoken of a difference between Fungus Medullaris and Fungus Hæmatodes, he proposed to arrange the formations which had passed under review, as constituting four species of Entozoa:—1. Tubercles found in the lungs. 2. Tubercles found in the abdominal organs, 3. Fungus Medullaris and Fungus Hæmatodes. 4. Carcinoma.

Mr. Carmichael next considered the exciting cause of tubercles, and concluded by urging that practitioners must direct their attention rather to the prevention than the cure of the disease.

A short discussion followed. Some objections were brought forward by Dr. Macartney, and answered by Mr. Carmichael.

Section F.—STATISTICS.

Mr. Kingsley presented and described several forms of tables, for more accurately displaying the revenue and expenditure of the United Kingdom, and procuring accuracy in Parliamentary Returns of the state of Savings Banks, &c.

Dr. Bowring observed, that those who complained of the imperfection of parliamentary returns, forgot that they were ordered, not for the service of general science, but to serve some special purpose, or as the foundation of particular motion. The means for procuring an accurate return of the revenue did not exist in this country. In most continental nations the whole gross amount of revenue is paid directly into the Exchequer; but, in England, several departments arrest the amount necessary to pay their own expenses *in transitu*, and the number of these departments renders the accounts of British finance very complicated.—Mr. Tiarcks said, that measures had been taken to remedy the abuses from the former mode of superintending savings banks. Weekly returns were now made to the National Debt Office of the most minute description. In the savings bank of Moorfields, the deposits amounted to 520,000*l.*, every penny of which was accounted for weekly.

Baron Dupin addressed the Section on the subject of a paper he had laid upon the table, entitled, 'Researches relative to the Price of Grain, and its influence on the French Population.' He had extended his survey over a space of fifteen years, from 1815 to 1832, but had stopped at the latter year, in consequence of the special derangement produced by the cholera During this interval, the price of corn in France had varied from 80*s.* to 34*s.* per quarter, and he proposed to examine the effect of this enormous disproportion on the elements of social life,—deaths, births, and marriages. From a variety of tables it appeared, that a difference of more than 100 per cent. in the price of corn produced an incomparably less variation in mortality than other causes which are unperceived; and that the effect of scarcities in the nineteenth century on mortality must be reduced to the rank of secondary causes, which can only be evolved by the artifices of calculation, and by grouping together a great number of years. The effect on births is scarcely greater—an increase of 50 per cent. on the price of grain pro-

duced only a diminution of 13-1000 in the births. On marriages the effect was rather more marked: there were 918 less marriages for every million during the year of greatest scarcity than there were during the year of abundance: but the years of greatest abundance were not the years of most marriages, nor of the greatest social happiness. Society was most prosperous when provisions were at an intermediate price. The small annual variation in births, deaths, and marriages, even for years of great difference of price, induced the Baron to search for *a function* of these three social elements, which would both render the variations more perceptible, and, correcting one by the other, would remove the perturbations arising from accidental causes. This function is the mean between the number of births divided by the number of deaths, and the number of marriages divided by the number of deaths. It is sufficiently obvious, that this function is independent of the amount of population, and the Baron considered that its magnitude is a very fair test of social prosperity. He proposed to name it the Function of Vitality. In the years of extreme scarcity, the function of vitality averaged 0.5937. In the years of high prices it averaged 0.6092. In the years of intermediate prices it averaged 0.6168.—He then observed, that, according to Dr. Cleland's paper, read on the preceding day, the function of vitality in Glasgow was about 0.7000—a clear proof that social happiness was greater in England than in France. He trusted that this function would be calculated for the principal continental nations and for different epochs, in order to compare their social prosperity by a precise and identical standard. As one valuable result, he showed that this function was far less in England during seasons of commercial depression than of agricultural distress.

In illustration of the Baron's views respecting the price of corn, and its relation to the function of vitality, Mr. Porter read the following table:—

	Price.	Baptisms.	Burials.	Marriages.
1801..	115. 1	237	204	67
1802..	67.9	273	199	90
1803..	57.1	294	203	94
1810..	103.2	298	208	84
1812..	122.8	300	190	82
1815..	63.8	344	197	99
1822	43.3	370	220	98

Lord Nugent remarked, that, while the population of France was notoriously increasing, the number of births appeared to be stationary. Baron Dupin said, that this was owing to the progress of civilization; fewer children, comparatively, were born, and fewer died.

Mr. Porter read the following table, in confirmation of the Baron's views:—

LONDON BILLS OF MORTALITY.

Deaths under 20 years of Age.

1751–60 ... 5$\frac{3}{4}$ per cent.		Difference between first and last of these decennial periods, 1$\frac{1}{8}$ per cent.
1761–70 ... 50$\frac{3}{4}$	—	
1771–80 ... 52$\frac{1}{4}$	—	
1781–90 ... 49$\frac{7}{8}$	—	
1791–1800 .. 49$\frac{7}{8}$	—	
1801–10 ... 47$\frac{1}{8}$	—	Difference between 1751–60 and the last of these decenary periods, 7$\frac{1}{2}$ per cent.
1811–20 ... 45 1-10	—	
1821–30 ... 46$\frac{1}{4}$	—	
1831–33 ... 42 1-3	—	

Deaths in Christ's Hospital.

1814–18	1 in 100
1819–23	1 – 128
1824–28	1 – 135
1829–33	1 – 157$\frac{1}{2}$

	Births	Marriages.	Deaths.
1697–1800	...1 in 36	...1 in 48	....1 in 123
1806–1820	....1 – 32	...1 – 49	....1 – 121
1826–1830	..1 – 34	...1 – 51	....1 – 128

Some inquiry was made respecting the effects of Vaccination, to which Mr. Porter replied by producing the following table:—

Persons dying of Small Pox within the London Bills of Mortality.

1750–1760	91	in 1000
1770–1780	102	—
1810–1820	43	—
1820–1830	35	—
1831–1833	23	—

Mr. Fripp thought it a great anomaly that a low price of corn should not, of necessity, produce a high function of vitality, and he attributed this to a want of forethought in the labouring population, owing to their deficiency of education.—Dr. W. C. Taylor said, that the anomaly was explicable on elementary principles. A very slight excess of supply above demand produced a very disproportionate fall in price. He instanced two or three cases in which the disporportion had been very great. Baron Dupin had noticed the great disdisproportion between the fall in price and increase of supply, both in the essay before the Section, and in his memoir on National Industry, addressed to the Institute in 1831. Dr. Taylor was of opinion that this was precisely the case in which Statistics failed us, for, whether the excess of supply over demand was small or great, of course within certain limits, the fall in

price was sure to be excessive.—Mr. Harman Visger supported Dr. Taylor's views.—Colonel Sykes and Dr. Turner stated, that from the result of their inquiries it appeared evident that human happiness always increased with the cheapness of the necessaries of life.—Baron Dupin observed, that when he said the greatest social happiness appeared at the intermediate price of corn, he did not intend the mean between the highest and the lowest, but a price a little above the lowest.—After some desultory conversation, the Delegates from the Asiatic Society were called upon to state the subject of their mission.

Col. Sykes said, that a proposal had been laid before the Asiatic Society by the Right Hon. Holt Mackenzie and Dr. Royle, for establishing a committee, with affiliated branches, to collect statistical information with respect to the natural and artificial productions and wants of India. The project has been already explained in the report of the Asiatic Society, published in this journal.* Col. Sykes read several extracts from the communications made to the Asiatic Society, by Mr. Mackenzie and Royle, showing that the resources of India were yet comparatively undeveloped, and that a vast supply of materials for manufacture might be derived from that country. He dwelt particularly on cotton, for which we were now principally dependent on America.—Dr. Taylor observed, that our empire over India was completely the supremacy of knowledge. He entered at considerable length into the question of the trade between India and the ports on the Levant and Euxine, which he stated to be constantly and rapidly increasing; and detailed some particulars of the markets of Cabul, Bokhara, and Herat, obtained from recent publications of the Calcutta government. He instanced, as a proof of the benefit that would result from the proposed series of inquiries, the advantages which British commerce had derived from the information collected by recent travellers in the East.—Mr. Porter confirmed this statement, and directed attention to the rapid increase of trade between London and Trebezond.—Mr. Visger stated, that he was engaged in a branch of manufacture which depended on the supply of lichens; and he could assure the Section that this branch of industry, almost entirely unknown, was rapidly rising, both in extent and importance. Lichens were imported to the amount of 100,000*l.* per annum ; but the supply of the more valuable sorts was already beginning to fail, and gentlemen acquainted with botanical science had been engaged to travel in search of them. Should this part of the subject engage the attention of the proposed Committee, he would gladly supply specimens of lichens, with descriptions, to the Asiatic Society; for he felt assured, from all the accounts he had read, that India was likely to be the habitat of some of the most valuable plants of the lichen tribe.—Dr. Robison, of Edinburgh, said, that there were two products of India likely, when sufficiently known, to become valuable articles of commerce ; he meant a pulp for the manufacture of paper, obtained from Nepaul, the paper derived from which was the only one that resisted the action of worms ; and a wood-oil which, from its durability and fragrance, was particularly worthy the attention of house-painters.—Lord Sandon, after some allusions to our ignorance of Indian statistics, dwelt very strongly on the necessity of attending to the cultivation of cotton in India. The stock of raw cotton, on the manufacture of which so large a portion of our population depended for subsistence, was often in a very precarious state. Of his own knowledge, there was a period, about eighteen months ago, when the stock on hand would not have supplied six weeks' consumption. We now depend on the United States of America for supply. He would not refer to the possibility of war with that power. God forbid that two nations, bound together by identity of origin, interest, and civilizing influence, whose bonds of amity were the strongest this world ever witnessed, should again engage in what was almost civil war. But he need not remind the Section that the Southern States, from which our supply of cotton is derived, are in a very ticklish state, owing to the existence of slavery, and the question of negro emancipation, which is likely to precipitate some sudden conclusion of no very peaceful nature by the Tex-

* See Athenæum, No. 417.

ian war.—Several gentlemen from the manufacturing districts professed their anxiety to aid the views of the Asiatic Society, in establishing the proposed Committee.

Section G.—MECHANICAL SCIENCE.

The sitting of the section occupied but a short time, during which two papers were read, one of some interest, by Mr. Henwood, on Naval Architecture, and a second by Mr. Coosham on certain improvements in Napier's rods. Dr. Daubeny also exhibited an ingenious instrument for taking up sea water from any given depth, for the purpose of chemical analysis, being an improvement of an admirable invention for that purpose sent out in the *Bonite*.

EVENING MEETING.

In consequence of the incessant rain, the intended promenade and horticultural exhibition at Miller's Gardens was abandoned, and notice given that the Geological, Statistical, and Mechanical Sections would meet in the evening.

In the Geological Section, Dr. Hare, of Philadelphia, entered upon a history of the many modifications of the Pile of Volta, and in particular drew attention to a form of it, devised, and long since described by himself, but which he conceived had not in a sufficient degree attracted the attention of European philosophers. His apparatus is compact, portable, and, what is a capital advantage, admits in an instant, and by the simplest manipulation, of being put in action, and having this action suspended. A prodigious quantity of acid is thus saved, which would otherwise go to waste, and the operator is enabled to avail himself, as often as he chooses, of that superior influence which is so well known to be manifested by the pile at the first instant of its excitation. Dr. Hare concluded by the exhibition of some striking experiments illustrative of the igniting or deflagrating efficacy of his Voltaic arrangements.

Prof. Philips followed with an account of the distribution over the northern parts of England of Blocks or Boulders. The Association, he observed, had formerly proposed a question regarding this distribution, and the present was a partial attempt at its solution; and it was interesting both to the geologist and the geographer, as it involved the effects of running water in modifying the surface of a country. In glancing over the north of England, we find a great variety of rock formations, from the oldest slates to the newer tertiary; the country generally slopes to the east, with the exception of the group of Cumbrian mountains, which form a local conical zone. One striking feature in its physical geography, is an immense valley running north and south, and passing through a great variety of formations; the Wolds of York being chalk, of Whitby oolite, the vale of York new red sandstone, while the carboniferous rocks are displayed in Northumberland and Durham. All the country from the Tyne to the Humber is covered with the transported boulders, many of which are of rocks quite different from any near the spots where they occur, and some even not recognizable as British rocks. Could Mr. Lyell's ideas regarding the office of icebergs be true, that they had been the means of transporting gravel to distant places? Boulders of the Shap Fell granite had been found in the south-eastern part of Yorkshire? in the interior, there were great acumulations of them in many places; their directions seemed all to converge to a certain point, in what is termed the Pennine chain, but on this chain no boulders have been observed, except at one point, from which you look towards Shap Fell; towards the north they have been drifted nearly as far as Carlisle, but there is no trace of them towards the west. We also may find boulders from Carrick Fell carried to Newcastle and the Yorkhire coast, and these have been drifted over the same point of Stainmoor. Mr. Philips gave several conflicting opinions of different geologists, to account for this extraordinary transportion; the bursting of the banks of lakes; the alternate elevation and depression of mountain chains, and the supposition that the entire country had been under the sea, when the distribution of boulders had taken place.—Mr. Sedgwick then rose, and remarked that the direction of transport of the blocks may have been modified by the surface over which they were carried; and that Sir James Hall

had been the first who had observed the Sharp Fell boulders. These boulders Mr. Sedgwick had noticed on the shores of the Solway Frith, mixed with gravel from Dumfrieshire. He alluded to the action of water upon the crests of mountains, and to the occurrence of transported blocks at considerable elevations. It was well known that mountain lakes were gradually filling up; and he had shown in a paper to the Geological Society the relation of a lake to the age of the valley containing it. With the diluvial gravel over the country we find the associated organic remains,—a strong proof that the land must have been dry when the transportation took place.—Mr. Murchison had observed these boulders associated with recent shells at various elevations,—consequently, the land must have been at one time under the sea, and have been subsequently elevated. There must have been a relative change of the level of land and sea; and Professor Esmark, in Norway, had been the originator of the idea of the icebergs transporting gravel. He referred to the valley of the Inn, in the Tyrolese Alps, as illustrating this alteration of level: boulders of granite had been found on calcareous mountains composing one of its sides, elevated five or six thousand feet above the sea level; and this valley could not have been scooped out.—Dr. Buckland was of opinion that the land must have been dry before the action of the water that had transported these blocks. There was a great number of organic remains mixed with the gravel, derived from animals existing on dry land; and this was not only true in England, but confirmed by observations in the continent of Europe.

In the Statistical Section, Dr. Lardner delivered a lecture on Steam Communication with India—a subject on which we have dilated too recently, and at too great a length, to return to it in the present crowded state of our columns.

In the Section of Mechanical Science, Mr. Whewell gave a short account of the present state of the science of the Tides. Though there can be no doubt, he observed, that the tides are to be reckoned among the results of the great law of universal gravitation, they differ from all the other results of that law in this respect, that the facts have not, *in their details*, been reduced to an accordance with the theory; and the peculiar interest of the subject at the present moment arises from this, that the researches now going on appear to be tending to an accordance of theory and observation; although much in the way of calculation and observation remains to be still effected before this accordance reaches its ultimate state of completeness. With regard to observation, the port of Bristol offers peculiar advantages; for, in consequence of the great magnitude of the tides there, almost all the peculiarities of the phenomena are magnified, and may be studied as if under a microscope. With regard to the theory, one point mainly was dwelt upon. By the theory, the tides follow the moon's *southings* at a certain interval of time, (the *lunitidal* interval,) and this mean interval will undergo changes, so as to leave less than the mean when the moon passes three hours after the sun, equal to the mean when the moon passes six hours after the sun, and greater than the mean when the moon passes nine hours after the sun; and the quantity, by which the lunitidal interval is less than the mean when the moon is three hours after the sun, is exactly equal to the quantity by which the lunitidal is greater than the mean when the moon passes nine hours after the sun. And this equality of the defect and excess of the interval, at three hours, and at nine hours, of the moon's transit, is still true where the moon's force alters by the alteration of her parallax or declination. Now we are to inquire whether this equality of excess and defect of the interval in all changes of declination, &c. is exhibited by observation. It appears at first sight, that the equality does not exist; that is, if we obtain the lunitidal interval by comparing the tide with the *nearest* preceding transit. But, in truth, we ought not to refer the tide to such a transit, because we know that the tide of our shores must be produced in a great measure by the tide which revolves in the Southern Ocean, and which every half day sends off tides along the Atlantic. The tide therefore, which reaches Bristol, is the result of a tide wave, which was produced by the action of the sun and moon at some anterior period. It is found, that if at Bris-

tol we refer each tide to the transit of the moon, which took place about forty-four hours previously, we do obtain an accordance of the observations with theory in the feature above described, that although the moon's force alters by the alteration of her declination, the defect of the luntidal interval for a three hours' transit of the moon is equal to the excess of that interval for a nine hours' transit. And thus, in this respect at least, the tide at Bristol agrees exactly with the tide which would be produced, if forty-four hours before the tide, the waters of the ocean assumed the form of the spheroid of equilibrium due to the forces of the moon and sun, and if this tide were transmitted unaltered to Bristol in those forty-four hours.

A Durbar

Lord and Lady Wm. Bentinck

THE INDIA REVIEW

OF WORKS ON SCIENCE,

AND

JOURNAL OF FOREIGN SCIENCE AND THE ARTS,

EMBRACING

MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS, &c.

REVIEW.

Sugar, as to the probability of an improvement in the cultivation and quality of, either through Europeans or Natives, in case of an increased demand : from the report of the select commitees of the Houses of Lords and Commons, appointed to enquire into the present state of the affairs of the East India Company, 1830-31.

Bell's Comparative View of the External Commerce of Bengal, during the years 1834-35 *and* 1835-36, *pp.* 106.

A Treatise on the Cultivation of Sugar-canes, and the manufacture of Sugar ; comprehending instructions for planting and saving the cane, expressing the juice, &c. &c. BY W. FITZMAURICE, *many years a planter in the island of Jamaica, pp.* 69, 1830.

The nature and properties of the Sugar-cane, with practical directions for the improvement of its culture and the manufacture of its products. BY GEORGE RICHARDSON PORTER, *Philadelphia, pp.* 354, 1831.

A Dictionary, Practical, Theoretical, and Historical, of Commerce and Commercial Navigation : illustrated with Maps and Plans. BY J. R. MCCULLOCH, ESQ. *Second Edition, Corrected throughout, and greatly enlarged : with a Supplement, supplying the deficiencies and bringing down the information contained in the work to October,* 1835. 8*vo. pp.* 1327. LONGMAN, REES, ORME, BROWN, GREENE, AND LONGMAN, LONDON, 1835.

(Continued from page 425.*)*

Having considered the history of sugar-cane, we proceed to other important particulars regarding the various parts of the cane, and their development. *Saccharum officinarum* is a genus of the *triandria digynia* class ; it has no empalement, but a woolly down, longer than the flower which encloses it : the flower is bivalve; the valves are oblong, acute-pointed, concave, and chaffy ; it has three hair-like stamina, the length of the valves, terminated by oblong summits, and an awl-shaped germen, supporting two rough styles, crowned by single stigmas ; the germen becomes an oblong, acute-pointed seed, invested by the valves. Bruce says that the cane may be raised from seeds in this country. It is, however, easily propagated by cuttings, and multiplies itself surprisingly. The torrid zone is most favorable to its production, but it may be cultivated as high as the 40° lat. The period at which it arrives at full maturity is from twelve to twenty months: there is, however, an Otaheitan variety, which comes to maturity in ten months ; this is only in elevated spots. In vale and low alluvial soils, where the land has not

been much cropped, the plant is oftener from 12 to 16 months in becoming fully ripe. It contains three sorts of juice; one aqueous, another saccharine, and the third mucous, the relative proportions of which and the quality of the two last depend upon particular circumstances, the knowledge of which is of great importance as regards cultivation. The cane, as in reeds, and other gramineous plants, has a knotty stalk, and at each knot, or joint, there is a leaf and an inner joint. The stole is distinguished into two parts; the first is formed of several peculiar joints, varying in number from five to seven, which are placed very near to each other, having rows of little points at their surface, which are elements of roots. These joints are called radicles, because their function appears wholly to consist in sending forth roots. They are divided from each other by a leaf called the radical leaf. The whole of these joints form the first part, or *primitive stole.* The joints are endowed with several rows of points, elements of roots, which develope themselves when requisite, and form, with the joints whence they issue, a secondary stole; they thus form roots, till the joints are sufficiently strong to put forth and sustain those which are to follow them, and form the stalk. The second part of the stalk becomes very strong, and seems to serve, alone, for the filiation of all the remaining joints. The roots issue from the development of the sap vessels, which are disposed in concentric rays, round each point, on the surface of the joint. The sap vessels of the root, cut transversely, exhibit a circular surface of a cellular tissue, and are covered with a skin, which is first white, and then brown or black. The roots are very slender and almost cylindrical; they are never more than a foot in length; a few short fibres appear at their extremities. The number of joints of the stalk or cane vary from 40 to 60 in the Brazilian cane; these are much fewer in that from Otaheite, its joints being further apart, some of which are eight or nine inches long. Mr. Porter says, that—

"The finer specimens of those of Brazil are from two to three inches in length. The joints vary very much in their dimensions; they are short or long, large or little, straight or bulging; and several of these differences are sometimes found in the same cane. The knots of the canes are not simple enlargements, as in the greater part of reeds, and the gramineous family of plants. They are rings, from an eighth to a quarter of an inch wide. Four or five rows of semi-transparent points go round their circumference. A circular semi-transparent line very perceptibly divides the outer from the inner joint. At the upper part of this there is a slight circular hollow, called the neck, which is terminated by the leaf belonging to the joint. The inner joint is entirely subordinate to the outer one, both in its development and growth. It is destined to perform a most important function; in it the juice, after having undergone various modifications, arrives at the state of its essential salt.* There is on every joint a bud, which encloses the germ of a new cane.

If the intimate structure of the various parts of the cane be minutely examined, its sap and proper or returning vessels will be readily discovered. The sap vessels are abundantly large and very numerous, being more in number than 1500. They are both simple and compound, and when cut transversely, one opening appears in a simple vessel; but if compound, two, three, or even four openings are distinctly seen by the aid of a magnifying glass. The function of the proper vessels is to separate the peculiar juices, proper to the plant, in the leaves, the rind, and the interior of the cane. They are symmetrically arranged, especially in the interior of the inner joint, in hexagonal cavities, similar to those of a bee-hive, forming, at equal distances, cells, placed horizontally, one upon the other. At a point somewhat raised on the stalk, each sap vessel divides itself into two parts, one continues the vertical direction, the other becomes horizontal; the latter grows interlaced with the vertical portion, and after having formed a partition of about a sixth of an inch in breadth, they unite themselves into a bundle or *fasciculus,* which pierces the rind, and forms the bud, which incloses the germ of a future generation. The buds always grow alternately on the opposite sides of the joints. The partition formed by the horizontal vessels separates the joints internally, and prevents all communication between them, as far as regards the peculiar function of each.

The vessels which continue in a vertical direction have, through the whole extent of the outer joint, one of their sides convex, and the other concave, till they again become round by the meeting of other vessels; the points of this union are marked by a semitransparent ring, which forms a line of demarcation between the outer and inner joints. This is the part of the cane where it is weakest, and most apt to break. The space left between the sap vessels, running from one partition to another, is filled by cells, which form the symmetrical disposition of the proper vessels.

* We denominate by this term, that portion of the juice which will crystallize.

The rind of the cane consists of three distinct parts: the rind, (properly so called,) the skin, and the epidermis.

The rind is formed of sap vessels, ranged in a parallel direction, on a compact circular surface.

The skin, which is very thin, is at first white and tender; it then becomes green, then yellow, as the joint approaches to maturity, the period of which is shown by streaks of deep red.

The epidermis is a fine and transparent pellicle, which covers the skin. It is almost always white.

At the upper part of the inner joint the rind divides itself into two parts. The inner part forms the rind of the following joint. The sap vessels of the outer part are joined by several other sap vessels from the interior, with which they rise, supported by a reticulated tissue, and form the leaf, upon which the skin and epidermis of the rind are continued.

All the leaves, except the three first radicals, are divided into two parts by a nodosity. The lower part of the leaf is sometimes more than a foot long; it envelopes the upper joints, folding itself very closely round them. Its inner surface is white, polished, smooth, and shining. Its outer surface is slightly indented, and bears a great number of very minute white thorns.

The upper part is four feet, and sometimes even more in length. After rising out of the ground it gradually recedes from the cane as it grows, and forms with it a proportionate greater angle in approaching to maturity. Its greatest width is two inches, thence tapering to a narrow point.

The nodosity is about half an inch broad; the texture of its skin is softer, thicker, and of a darker colour than the other parts of the leaf. It has, on the inside, a very thin membranous fold, very tightly applied round the body of the cane. A channel for the rain is formed by the upper part of the leaf, and this fold, which is, at the same tine, a barrier against extraneous bodies, and protects the young joints, at the time of their development, from the attack of insects, which might otherwise destroy them. The leaves are placed alternately on the joints, and expand at top in a kind of fan."

The author, from whose able work we have just quoted, adds, that the natural history of plants shows the phenomena of the fructification and fecundation of the germ, the laws which this germ follows in its development, the different revolutions which the plant undergoes from its birth to its total decay, and the various accidents of the different periods betweeen these two terms.

"To conduct the cultivation of a plant on enlightened and rational principles, it is indispensable that the cultivator should have a thorough knowledge of its natural history. This will teach him what soil and what climate agree best with the plant. In understanding the most favourable circumstances of its vegetation, he discovers the causes of all the accidents to which it is liable, and is best able to guard against their recurrence, at the same time that he is necessarily conducted to the better knowledge of the nature and the quality of its products.

All the parts of the cane form, develope, grow, and rise, successively, one upon the other, in such a manner, that each particular part is a whole, which appears to pursue its own course, independent of the other."

We quote the foregoing, because there are among our readers some who may deem the description we have given above as not necessary to the cultivation. Mr. Porter thus traces the development of the plant.

"The bud consists of the germ, tightly enclosed within little leaves. The development of this germ is necessarily governed by the same laws, in every part of the cane in which there is a bud. The radical knots can easily be perceived and examined in their first development, especially upon buds developed on the upper part of a cane. If the head of one be cut off, its buds, then receiving the juices which would have continued to nourish the head, are sometimes sufficiently developed to throw out twenty joints. After having removed the radical leaves, the first cane joint is generally discovered under that of the fifth knot—it is known by the appearance of the bud; if it be without this, it must be reckoned a radical knot, then the following joint will have the bud; but if that, too, be without, which very rarely happens, the bud will certainly be found on the next or seventh knot. It is from the centre of the last radical knot that the germ of the first cane joint springs. This germ encloses the vital principle of the cane, and of the generation of the joints. The first, in forming itself, becomes the matrix of the second,—the second of the third,—and so on, in succession. There is always a degree of difference in the various revolutions of each joint, marked by the time of its generation; so that the joints of the cane may be considered as concentric circles, the centre of which is always occupied by a point, which, expanding into a circle itself, is replaced by a new point; circles which, rising successively one upon the other, enlarge, and arrive, in a given time, at their greatest diameter.

When circumstances are very favourable for vegetation, it often happens that, immediately after the first development of the cane joints, which form the secondary stole, the bud of the first of these joints throws out its radical roots, and forms a second filiation on the first, the bud of the first cane joint of this second filiation also sometimes developes, and forms a third; these two last soon become very nearly as forward as the first, and, like it, form canes.

Two distinct operations are carried forward in the cane; the one belongs to the sap vessels, and, reaching to every part, sheds its vivifying power through the whole plant; the other belongs to the system of its proper vessels, and maintains the functions proper and peculiar to each joint.

It would, perhaps, be tedious minutely to follow the plant through all the different shades of its developement and growth. Its juice is, of course, variously modified in all its different stages: in its first formation it has all the characteristics of that of unripe mucous fruits; after a while, it very much resembles, both in taste and smell, the juice of sweet apples; by degrees it loses this, and takes the smell and taste peculiar to the cane.

The first joint requires four or five months for its entire growth, and, during this time, fifteen or twenty joints spring from it in succession, and the same progression continues as, by degrees, each joint arrives at the period of its growth, which is ascertained by the decay of its leaf: this is the period of its maturation. When the leaves of the two or three first joints which appear out of the earth have died away, there are then about twelve or fifteen leaves at top, disposed in the form of a fan. If the cane be considered in its natural state, it has at this period acquired all its growth, and arrived at the usual epoch of its flowering:* if it blooms, the principle of life and generation passes entirely to the development of the parts of fructification; at this period, the joints which spring forth are deprived of their bud; and the sap vessels, with which they were supplied, pass into the leaf; whence it happens that, as the number of these vessels are constantly diminishing, the joints in a similar proportion become longer, and their rind thinner. The last joint, which is called the arrow, is four or five feet long; it is terminated by a panicle of sterile flowers, which are eighteen or twenty inches high. If the period of flowering is delayed by cultivation, then the principle of life passes to the generation of new joints, and this continues till the sap vessels of the stole become woody, and do not afford a passage to the aqueous juices."

The other particulars, to which we beg to call the attention of those interested in this important subject, is the influence of soil and climate, in the cultivation of the cane. It is to be understood that plants containing mucous juices feel most sensibly the influence of soil and climate. Porter observes—

"Their juices abound more in saccharine matter in light and loose calcareous soils, than in rich and marshy lands. They require a favourable situation for receiving the influence of solar light and heat, as well as air; most important agents in elaborating and perfecting the saccharine portion of the plants.

Although the cane appears not to differ in kind, there are great modifications in it, as well as in its produce from the same kind of cane: these are marked in the most decided manner, not only in different islands, but in different parts of each. Rumphius, who has considered the cane only as a naturalist, remarks three varieties, and, according to this author, the Chinese distinguish two. The first, they named *Tecsia*, which has a thin rind, the second *Gamsia*, whose rind is thick.

The French introduced plants from the East Indies into their West India Islands, whence they found their way into some of our colonies. Sir John Laforey, who planted some of these, as well as some canes from Otaheite, in Antigua, soon discovered their superiority over the old canes of the West Indies. He gives the following account of them.

One sort was brought from the Island of Bourbon, reported by the French to be the growth of the Coast of Malabar.

Another sort from the Island of Otaheite.

Another sort from Batavia.

The two former are much alike, both in their appearance and growth; but that of Otaheite is said to make the finest sugar. They are much larger than the Brazilian, the joints of some measuring eight or nine inches long, and six in circumference.* They are ripe enough to grind at the age of ten months;† they appear to stand the dry weather better,‡ and are not so liable to be attacked by that destructive insect, the borer.§ Indeed, these

* The flowering rarely happens, and never but to a very small proportion of some very few fields. Those canes which flower have very little juice left, which is by no means so sweet as that of the rest.—*Roxburgh.*

On some soils, when the cane is planted early, and a vigorous vegetation is suddenly checked, it is often found to flower.

* Their colour, and that of their leaves, also differ from ours, being of a pale green; their leaves broader, their points falling towards the ground as they grow out, instead of being erect like those of our Islands. Their juice also, when expressed, differs from that of our canes, being of a very pale, instead of a deep green colour.—*Sir John Laforey.*

† A few cut for trial, above twelve months old, were judged to have lost part of their juice by standing so long.—*Ibid.*

‡ I observed, that after a drought of long continuance, when the leaves of our own canes began to turn brown at their points, these continued their colour throughout.—*Ibid.*

§ A gentleman of Montserrat had some plants given him in the year 1791 by Mr. Pinnel, one of the most considerable planters of Guadaloupe, who told him that, in the preceding year, when an exceeding great drought had prevailed, he had, amongst a large field of the Island canes, half an acre of these; that the want of rain, and the ravages of the borer, had damaged the former so much that he could not make any sugar from them, but that the latter had produced him three hogsheads.

In the spring of this year, 1794, a trial was made of the Malabar canes on one of my plantations; 160 bunches, from holes of five feet square, were cut, they produced upwards of

are considered so much superior to the old canes, that their adoption has nearly banished the original Brazilian plant from our Islands.

The Batavian cane is of a deep purple colour on the outside; it is small in circumference, but bunches exceedingly, and vegetates so quickly, that it springs up in one-third of the time that the common cane does.

In new and moist land, such as the colonies of Dutch Guiana, the cane grows to the height of twelve, fifteen, or even twenty-feet. In arid calcareous soils, it sometimes does not attain a greater height than six feet, and one of ten feet is considered long.

Dutrone mentions five varieties, which he classes in rather a fanciful manner. Perhaps these varieties may be merely the effects of different soils and situations. But even if this be the case, his observations are made with so much laborious accuracy and acute comment, that they may be found useful in imparting a thorough knowledge of the cane in all its bearings; he will therefore give a slight sketch of these varieties. He says, "After the numerous observations I have made upon the changes and modifications which the cane receives, not only from soil, climate, and cultivation, but from the influence of the seasons, from the air, the light and the sun, from moisture or dryness, I believe I am able to enumerate all the varieties of this plant. I distinguish the cane as hardy and tender, and I again distinguish in these two states, particular gradations." We will not be quite so diffuse as the author in describing these.

The most hardy kind is firm upon its stole, resisting the wind which never lays or breaks it. It supports, equally well, much moisture or dryness, and goes through its progressions slowly; it rarely begins to decay before eighteen or twenty months. This sort of cane is the best and most rare. The top part has fifteen or sixteen joints, the leaves of which are verg long and wide, their colour is of a fine green, the joints of the cane are very large and bulging, and about two or three inches long. They are yellow: sometimes they have a green tint, especially when the land is new. The buds are very large; the number of joints is ordinarily from thirty-five to forty-five. This cane is very little affected by a backward season. Its juice is abundant. The great proportion of mucilage which it contains, renders it difficult of clarification. It is rich in sugar of excellent quality, the concentration of which is very easy especially when the degree of heat does not exceed 230° of Fahrenheit. This cane must never be cut before eighteen or twenty months growth. The cane in the next degree hardy, must be cut at from sixteen to eighteen months. It has generally from thirty to thirty-five joints, not so large as the hardiest cane. Its juice is very abundant, and easy to clarify, yielding the essential salt abundantly. The cane in the third degree hardy, grows on high grounds, and requires abundance of rain: it ought to be cut at fifteen or sixteen months. The top has from ten to thirteen joints, with short straight leaves of a yellowish-green. The cane has from twenty to thirty joints, which are very little bulged, sometimes quite straight; they are only one or two inches in length, their colour is yellow, a backward season has a very sensible influence over it. Its juice is not very abundant, but it is of very good quality, sometimes it has a great deal of mucilage, which renders the clarifying difficult, and impedes the extraction of its essential salt, especially when it is exposed to a great degree of heat; 238° or 239° of Fahrenheit is decidedly too high: when so highly heated, the mucilage is found in the greatest proportion, and is most prejudicial.

The tender plants are divided into good and bad, the former is most general: it grows in the plains. Its constitution is modified, but not changed, by the nature of the soil; much rain still further weakens and renders it bad. Extreme dryness causes it to wither; its maturity is dependent on the season, it being commonly completed at eleven or twelve, but sometimes not until fifteen or sixteen months. The wind often lays and sometimes breaks it. It is frequently bent and crooked. The top part has twelve or fifteen joints, with leaves two or three feet long, the colour of which is a very delicate green. The cane has twenty or thirty joints, the thickness of which depends on circumstances; they are about three or four inches long, very little bulged, often straight, and sometimes even slightly going in. Their colour is a deep yellow, with streaks of red, which appear as they approach maturity. The juice, which is sometimes very abundant, is easy to clarify. In favourable seasons it is rich in essential salt of good quality; in a backward season, the juice is very poor; it requires a very moderate heat for its granulation. The bad sort of the tender cane grows in humid and marshylands, it also grows in lands which have been newly put into cultivation. Extreme dryness is favourable to it, as much rain always injures the formation and secretion of its saccharine matter. It is weak on its stole, as the wind always lays, and very often breaks it. Its period of decay is from fifteen to sixteen months. Its top has fifteen or sixteen joints, with long wide leaves, of a deep green colour. The cane consists of

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350 lbs. of very good sugar; the juice came into sugar in the teache in much less time than is usually required for that of the other canes, and threw up very little scum. The produce was in the proportion of 3500 lbs. to an acre. The weather had then been so very dry, and the borer so destructive, that I am sure no one part of that plantation would have yielded above half that quantity from the other canes in the space of ground.—*Ibid.*

In April, 1798, two acres and a half of Bourbon-canes, in St. Thomas in the Vale, one of the most exhausted parishes in Jamaica, yielded near eight hogsheads of above sixteen hundred-weight each, of clear and strong grained sugar; which gives above 5,700 lbs. for the produce of each cane.

A writer from Tobago says, this cane passes wonder, and renders the appearance of the old canes unpleasant. I could not, as a planter, have credited on report, what I have witnessed of it.—*Macpherson's Annals of Commerce*, 1805.

twenty or thirty joints, four or five inches long, rarely bulging. The colour is a pale yellow, sometimes approaching to green. Its juice is often very abundant, the clarifying is always easy, and after a long drought, the best are rich in essential salt which is very fine, and easily obtained, if the boiling be well conducted. After abundant rains, particularly in a backward season, the juice is very poor, and contains a greater or less proportion of mucous juice, which has been prevented by these circumstances from forming into essential salt. The boiling must consequently be managed with the greatest care, to obtain the essential salt. The cane is often badly made and crooked. From all these particulars, it is evident how needful it is, to the successful cultivation of the cane, that its general nature and peculiar functions should be understood, so that we may know how, most judiciously, to direct and assist the action of the various agents of vegetation and maturation. Water being one of the most powerful of these agents in the vegetation of the cane, the cares of the cultivator should be directed towards the best means for supplying it, and for causing the cane to profit, as much as possible, by all that it receives, either in the form of rain, or by irrigation. As a principal means of effecting this, the ground should be very much loosened round the plant, the facilities for which operation necessarily vary according to the nature of the land, and many other circumstances."

Before giving our author's directions for diminishing or removing these obstacles, it will be necessary to allude to his opinion as to what soil is most favorable to the production of the cane; whence may be deduced the remedies required to approximate other soils; but we must postpone the subject until our next.

Art. II.—On the production of silk at Kamptee. By Miss Anna Calder, *with* Mr. Prinsep's *Report on the specimens forwarded.*

Raw Silk, from a printed copy forwarded to the Agricultural Society of India. By George Norton, *of Madras.*

Experimental cultivation in Western India.

Extract of a Letter from Mr. Shakespear, *on an improved method in winding silk.*

On the Silks of Assam. By Captain Jenkins.—*Trans. Agricultural and Horticultural Society,* 1836.

We shall now proceed to present our readers with some valuable papers in the Transactions of the Agricultural Society of Calcutta, for 1836, in order that the discoveries of zealous horticulturists may be diffused not only throughout our Indian possessions, but spread into Europe and America. We shall first consider the various articles on the culture of the mulberry plant, mode of rearing the worm, and the manufacture of silk. The first article is from Miss Calder, who observes, that the specimen of silk forwarded by her, was collected—

"From November, 1827, to August in the following year, in which month I was obliged to give them up; and during the first two I met with many accidents in rearing the insect, being then perfectly unacquainted with all its enemies, of which I found, by experience, a host to contend with. I had but a trifling produce, merely sufficient to teach me the culture and the spinning it off the cocoons, in which I wasted much, having no instruction or any thing to guide me but my own ideas; after that, my stock increased, and was generally from three to four thousand, sometimes not near so many, in the month. I was however very limited in my means for keeping them, having only a small bathing room for the purpose, and in attendance also, for the care, spinning, and all was performed by myself and two little girls under the age of twelve years (natives), one of whom is with me now, and equally anxious with me about our industrious little favourites; neither had I then one mulberry leaf in my own compound. The skein which I send is but the sixteenth part of what I can produ, besides I have used some and given much away to my acquaintance, never supposing that I should offer myself as a candidate for support in the culture of silk; but I find myself in a station so adapted to the purpose, that I have no doubt, with a little assistance, I could make the article an object with every poor person who had a spot whereon to plant a mulberry-tree, so simple is the mode I adopt in the care of it. Here, within the limits of my own compound, I have sufficient food for millions, large overgrown trees of the finest description; and I even think I shall be able to make the worm feed itself, after a while; but as I never had an opportunity of trying that experiment, I will not be positive; time will tell. Just now my object is to see what my own single effort would be likely to produce from this spot; but as I have not the means of accomplishing that, I should require assistance, for the purpose of raising sheds with chunamed reservoirs for water, a couple of men to attend the trees, bullocks to water them, and women or girls, whom I would teach to collect and wind the silk, whilst the insect itself would require the care of one steady person and some boys, all of course under my own eye. Now all this I cannot afford to do; but my positive belief is, that it would, in the course of twelve or eighteen months, amply repay

the trouble and expense. There are other things, such as wheels, baskets, &c., required. It is not many years I believe since the Government made an allowance for a like experiment, but without a similar prospect of advantage to that which I foresee, and my most anxious wish is, that it should reap one through the efforts of a female, whose greatest reward and pride would be to see the general culture of an article which constitutes her greatest amusement, extend itself over a country where it has been hitherto unknown, and where, of all other places, it is the most suitable. During the short period I kept them, they drew my admiration so entirely that I studied them with the most intense interest, and am now so well acquainted with their habits, that I could detect a sick one amongst a thousand. Should my plan meet your approbation, and the specimen I send be worth acceptance, I shall be most happy. I must, however, say it is not worth so much notice now as it has been, having lost much of its brilliancy during the long time it has been laid by, and by the many hands it has passed through for inspection. The thread has been wound through hot-water, and contains fifteen or sixteen of the cocoon threads.

"Some months ago I did myself the pleasure to address the Society on the culture of silk, although I had not at the time succeeded in procuring a number of worms, having since been many times disappointed by the insects dying on the road and even being destroyed by ants in the banghy. I have now the pleasure to state that I ultimately succeeded in having, from a parcel which arrived on the 31st of December last, about forty-two, but in a very weak state, and though I afterwards got a few others, I consider those as the parent stock. It will serve perhaps as a proof that on care and good feeding depends all, when I say that those sent were wretched bad cocoons and took 39 days to spin, they then remained 14 in the crysalis state, but from care I found them improve every time, and that they now spin in eighteen days and remain enclosed but nine. How much they may improve I shall be able to say hereafter. The late two months of hot winds prevented my doing more than to keep them for stock, and I have now a number in high health. As I had so few at first I did not collect the cocoons until the third generation; and after saving a great many for eggs I found to my surprise I had upwards of twenty-one lbs. weight, when the winds put a stop to them: though, were proper places erected to keep the worm, I am convinced they could be reared at all times as the mulberry is in as firm a state then as at any other time. I perused with great interest a letter from Messrs. Dover and Norton, read at one of your meetings some time back, and the specimens which accompany this, I collected as well as I could after their directions; I also remarked at your last meeting the silk sent from Bombay. That I now send is, No. 1, the first ever taken at this place and by myself, No. 2, also by me, and No. 3, the work of a native woman who never attempted it before, and to whom, with a strict injunction as to care in not wasting it, I gave one ounce of cocoons; whether the produce be sufficient I am unable to say; I labour under sad ignorance as to gathering the silk, nor can I comprehend what the gentleman meant, whose opinion was quoted on that from Bombay, by saying it would be better if collected in the Bengal manner, being twisted by a wheel ere it reached the reel. Could I be informed on this subject, it would be the means of forwarding my object greatly; indeed, were a proper apparatus forwarded to me through your kind interference, I should be most thankful, and gladly bear any expence that might be incurred as to the making, carriage, &c. also I should like much to know in what manner the refuse silk, such as the perforated cocoons, and so on, disposed of. I submitted this silk, through the Resident, for the inspection of His Highness the Rajah of Nagpoor, who was greatly pleased, and sent it to a committee of native silk merchants, whose report was mighty flattering to me, so much so, that His Highness has kindly volunteered to assist me by bestowing some ground and giving people to cultivate it for a year. I only now, therefore, require information on the subject, as even here the natives seem most anxious about it, flocking in numbers and offering their services, so aware are they of what is likely to be the result. As a proof of the improvement I send two or three of the original cocoons and as many of the last."

Mr. Prinsep, in forwarding Miss Calder's communication to the address of Mr. Robison, observes that—

"The principal defect in her silk is, its want of staple, and it is one of most serious consequence; by this is understood a want of adhesion of the various fibres which compose the thread, and I should conceive it to be owing to its not receiving the usual twist while being run off from the basin to the reel. This twist is acquired by winding always two threads at the same time, each being composed of its proper number of fibres or cocoons. They pass in a parallel direction to an iron director which has two small holes in it for the threads to run freely through, and then the two threads should be crossed round each other from four to eight times, according to the strength of the cocoon fibres, before they again pass through the eyes of the reel-guide on the reel according to the following ground plan:

This crossing, while the thread comes soft from the warm water, gives a consistence to it which can not be acquired by any other means; it also serves greatly to clear it of imperfections which will invariably fly up from the cocoons during the rapid process of reeling. To make the reeling perfect also it is necessary that the *reel-guide* should have a lateral motion while the reel goes round, it will then lay the thread cross ways upon the reel and prevent its becom-

ing entangled when the skein is taken off; but perhaps the Society will send her up a small model of the Italian Novi reel, which is most approved in the Company's factories.

In reply to some queries regarding the process of the worm itself, I have the pleasure to add some particulars from which Miss Calder may, by comparison, estimate the value of the produce of the worms of Kamptee, which from her description appear to be of very different character from those of Bengal. We have two descriptions of worms, the annual and the monthly one; of the first the worms are kept in a close vessel for a twelve-month, at their term of ripeness, they eat for forty-three days, they remain dormant one day, and then complete their spinning in two days. In fifteen days more they eat their way out, if not killed in the inside of the cocoon, by exposure either to the noon-day sun or to the heat of an oven; on the same day that they emerge from the cocoon, they will, in twelve hours, lay on the average 400 eggs, and they then die. One maund of 80 sicca to the seer of these cocoons will yield about 3 seers of good silk in the skein.

The other worms, called generally the small cocoons, which ripen almost every month during the year, in different parts of the country, are of very inferior quality. The egg hatches in eight days, the worm then eats for twenty-four days, remains dormant one day, completes its spinning in one day, and will emerge in eight days, if not destroyed as above-mentioned. In three hours after emerging, it lays 300 eggs on the average. One maund of eighty sicca weight to the seer, will yield on average about 2¼ seers of good silk in the skein. There will be produced at the same time, from this weight of cocoons, 25 chittacks of chassum, or waste silk, the remainder is dirt or dead cocoons.

Should Miss Calder require further information regarding any stage of the production of raw silk, I shall be most happy to make my experience, or my services in enquiry, available to her, and I shall be more punctual, I hope, in doing so. I shall be very glad to see the result of her comparison of our cocoons with her own, as well as specimens of her future filature."

The most important documents, however, are the following.

RAW SILK, FROM A PRINTED COPY FORWARDED TO THE AGRICULTURAL SOCIETY OF INDIA, BY MR. GEO. NORTON, OF MADRAS.

"The immense extent of the importation of this production from the Eastern part of the world, and the great probability that it will still largely increase, and enable the skill and exertions of our manufactures to make this country the mart of the world for silk, as it is for cotton manufacturers, are we think, sufficient reasons to draw strongly the attention of all those connected with our trade and possessions beyond the Cape of Good Hope.

We will first attempt, in the clearest manner we are able, to describe the climate best adapted for the cultivation of the worm,—how such cultivation is practised,—and the aptest method of drawing from the cocoons or nuts, which the insects spin, sufficient fibres to form a thread.

The climate best adapted for the cultivation of the worm, is the borders of a mountainous or high country, where the air is warm, yet temperate and regular. Thus, the best cultivated in Europe is in Piedmont, the Milanese, and the Tyrol; which countries border on the Alps: and indeed the silk produced in all parts of the North of Italy, which are mountainous, is good, for there the sky is clear, and the air warm, yet temperate and pure. The worm cultivated in the valleys, where the warmth is great, exudes a looser and more irregular fibre, and the thread formed from it becomes rather harsh and sticky.

The manner of cultivation practised in Italy is as follows:—First, there are the growers of mulberry trees, who, when the trees have arrived at sufficient growth to allow of the leaves being plucked without injury to them, pluck and sell the leaves by *weight* to the breeders of the worms: of which there are two sorts; first, those who breed to sell the eggs which the worm produces, always reserving a sufficient quantity to keep up the stock; next, those who purchase such eggs, which are also sold by *weight*, merely to feed the animal until it spins its nut (or cocoon as it is called)—which nut or cocoon, in order to destroy the worm within (which would otherwise break all the fibres it had spun in easing its way out, when in the course of its various transmutations it would be called by nature again to life and activity), is either baked or suffocated by *steam*. The latter is by far the better method; for without great care in *baking* the fibres of the cocoons get burnt, which creates much *waste*.

These last breeders sell the cocoons, by the weight, to those who draw the fibres from them to form the thread; which is called reeling, or filaturing, the silk. This is performed in the following manner; first, the cocoons ought to be always, and are so, in regular filatures, carefully sorted into the various sizes of the fibre upon them; then the quantity of cocoons intended to form the thread is put into a small bason of hot water, which enables the fibres to run freely from them: then the fibres from each of the said quantity of cocoons are passed through an eye in a small wire, extended above the bason of water, in order that in joining together they may receive a slight twist, which gives the thread an elasticity, and the greater such elasticity, the more valuable the silk. After that, they are fastened to a reel, which is *not circular*, but should be formed of four projecting sticks of wood, with even tops to them about one inch broad and four inches wide, with borders at each end to prevent the silk, in reeling, from slipping off; and the extent of such projecting sticks should be such as to form a skein of about 30 inches

diameter. Then the reel is turned round, and the fibres drawn from the cocoons until a skein is made. Now, great and particular care must be taken by the person who superintends the cocoons in the bason of hot water to brush them properly with a small birch broom, in order to loosen the fibres, and keep the cocoons clear of the fluff upon them, which, if allowed to run into the thread, renders it woolly and wasty (which is much the case in all Bengal silks), and also to take care that never *more* or *less* than a given quantity be running at the same time, otherwise the thread will become uneven, which unevenness is a very great fault, prejudices the silk in a very great degree, and essentially spoils it for many purposes of manufacture, as, in weaving, it will show the unevenness in the cloth.

The quantity of cocoons to make a thread are various; and in Company's Bengal silk they are distinguished by letters. Thus, A. 1. is 4 to 5 cocoons; that is to say, the thread is formed of not less than the fibres of 4, or more than the fibres of 5, cocoons: A. 2. is 1 to 8 cocoons; B. 1, 10 to 12 cocoons; B. 2, 12 to 14 cocoons, and so on; making, as the thread gets larger, a difference of *two*, instead of *one*, cocoons; as, from its size, such a difference will not cause any perceptible irregularity. But, in Italy, in filaturing, or reeling, some of their finest silks, they are so particular and attentive to the *evenness* of the thread, that they will commence with three cocoons, and, when they are run towards the end, they will then add another cocoon; as the worm spins its fibre smaller as it draws to a close.

Next, the situation of the filatures to reel the silk should be particularly attended to. They should be where the air is pure, temperate, regular, and dry; and in the neighbourhood of good soft water, which is of the utmost consequence, as none but what is soft, or made so by some means, would do; for which purpose, it would be always better, to have the water drawn into a large cistern, and stand exposed to the sun for some time, in order that it may penetrate and soften it. Indeed, so delicate is the nature of silk, that a cloudy day will have an injurious effect upon it; and the reeling should, if possible, be on such occasion avoided. In Bengal, where they have several harvests, those silks which are filatured in the rainy season; are always much inferior in the colour, more wasty, and loose in the thread.

Now, after paying strict attention that the silk is filatured in the manner we have pointed out, care must be taken to keep each sized thread from the other, to separate the yellow gum, from the white gum silk, and have each sort, both colour and size, packed in *separate* bales. There is a fault which also attaches to some of the Company's inferior filatures, which is, that a larger reel is made use of than the one we have described, and the long and short reels are mixed together in the same bale. This ought to be studiously avoided.

To sum up all in a few lines,—the valuable properties of silks are, that the colour be clear, and the thread clean, even, and elastic. The *clearness* of the colour is produced by the pureness of the atmosphere in which the worm is bred, and the care taken to filature the cocoon in a proper situation. The *clearness* of the thread arises from the attention of the person who presides over the cocoons, when in the bason, to keep the water clean, and to brush away all the fluff. The *evenness* of the thread is owing to the regularity of the number of cocoons. And the *elasticity* is acquired by having pure soft water, and keeping it always heated to a degree somewhat beyond tepid.'

DOVER AND NORTON.

Great Winchester Street, London.

The next communication to which we shall allude, is

ON AN IMPROVED MACHINE IN WINDING SILK.

Extract from a Letter from Mr. Shakespear to the Board of Trade, 2d June, 1832.

Reporting on the new arrangement of a condition or drying room whereby to improve the means of protecting Raw Silk from damp and of getting up.

1. When last in Calcutta, I met with a pamphlet of considerable celebrity on the subject of the "Silk trade" in which there are some very apposite remarks on the great advantages arising from the public drying, or condition rooms, in Lyons, founded by Government in 1805.*

The Honourable Company's investment at the Gonatea & Rangamatee Factories.

2. Fully impressed with an opinion that the principle, if practically followed up in these factories, would be infinitely beneficial in protecting newly spun Silk from the sudden changes of weather in Bengal, and the extreme humidity of the atmosphere acting upon so absorbent a fibre, especially during the manufacture of the cocoons Silk of the rainy bunds, (which are reeled off with all practicable expedition in their *green* state, or unovened) I have not hesitated to fit up, with glass doors, venetians, and shutters, a large old godown at Rangamattee (measuring 40 feet by 30) as "a condition or drying room," in which are placed two pair of my pottery ghye stoves having

Condemned in 1828, by the Executive Officer, but retained at the suggestion of the present Resident.

* Dr. Lardner in his Cabinet Cyclopædia does not touch on this material point in the manufacture of silk.

Simply a water jar, of about 2 feet diameter, cut into two parts, which cap the two stoves; each having a valve or smoke pipe to draw off the smoke to the usual circular chimney shaft of the pottery ghye.

hemispherical tops (in substitution of the cocoon basins). Thus a moderate temperature, by no means oppressive, regulated by a thermometer and ventilator, may at all times be kept up, and the room being glazed, the process of weighing, sorting, and packing, will all be carried on with great security in the worst weather, now altogether impracticable without the certainty of the bales being packed damp, an evil so much complained of at the Export Warehouse, and by the brokers in London. The injury increasing by the heat of the ships hold.

3. The new silk of each day will be hung up in the usual mosses, or bundles of skeins, or distributed on horses and shelves made for the purpose, and thus remain 24 or 48 hours, according to circumstances, before being weighed, sorted and embaled. The *decrease in weight* will be very trifling, no factitious practices being resorted to by the operatives in Bengal, as in Europe by the throwsters, to moisten and increase the weight by soap and dirt, which is there paid for as silk by the manufacturer.

Found to average between 2 and 3 chittacks per maund, February 1833.

6. I am induced to hope that the effect of this arrangement may prove beneficial to the investment, consequently satisfactory to your Board. And that it may accordingly be brought to the notice of Government as an expedient hitherto I believe never thought of or had recourse to at any of the Honourable Company's Factories.

At the trifling outlay of Rs. 287-15-4, paid for out of the profits on the potteryghyes.

"Qui non proficit, deficit."

Mr. Secretary Macnaghten's Reply of the 11*th of June*, 1832, *to the foregoing.*

"The Board being persuaded that you were actuated by the most praise worthy motives in incurring the expence of Sa. Rs. 287-15-4, as reported in your letter of the 2d instant in the preparation of a "drying room" at the Rangamattee Factory, they do not hesitate, in the present instance, to sanction that expenditure."

(A True Extract.)

COLIN SHAKESPEAR, *Resident.*

REMARK.

Of the advantages of this scheme I can now speak with confidence: many hundred bales of Raw Silk having been packed in the past year, in a state of "*dryage*" and perfection hitherto unknown.

15*th February*, 1833. C. S.

The following paper on disease among silk worms is important.

TRANSMITTED TO THE SOCIETY THROUGH GOVERNMENT.

To L. R. REID, ESQ.

Secretary to Government.

SIR,—I have the honour to inform you that I have dispatched from Darwar a further quantity of St. Helena silk-worms' eggs to the address of the Secretary to the Bengal Government, Territorial Department.

2. I had found that most of the country worms in and about Darwar were cut off by disease within the last two months, and that the portion of the Italian worms already hatched from the St. Helena eggs had shared the same fate, I therefore took the liberty of sending off the remainder to Bengal as the only chance of saving them.

3. With reference to your letter of the 13th ultimo, enclosing the copy of a communication from the Commercial Resident at Soonamooky, I have to report that I have commenced supplying cuttings of the white mulberry by the letter post as desired, and that I shall continue to do so until I receive information from Mr. Shakespear that a sufficient quantity has been sent.

4. I have to express my thanks to Mr. Shakespear for his remarks on the cultivation of the mulberry in Bengal. The two varieties which I have sent for introduction to Bengal are distinct from those of which Mr. Shakespear was so kind as to forward specimens. The "dasee" or "indigenous mulberry" is cultivated about Poona and in the southern Mahratta country.*

The "bedasee" I take to be the same as a third variety I received from St. Helena with entire pointed leaves and a whitish bark. Admitting the *morus alba* and *morus Indica* to be originally specially distinct, I should say that the "dasee" and "bedasee" are varieties of *morus Indica*, and that the larger white mulberry (entire leaved,) and the "doppia foglia" are varieties of *morus alba*. However, the several kinds of mulberry used for feeding worms have been so modified by cultivation, as to render the distinguishing marks between a species and a mere variety extremely difficult to ascertain. In order to prepare the way for more correct information on this subject, I herewith forward specimens of several kinds of mulberry, with an outline of an arrangement of the *genus morus*, which I beg to request may be sent to Bengal for comment or correction.

5 There are two important points yet to be established with regard to the several kinds of mulberry.

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* Vide Specimen.

1st. What kinds do the worms prefer?

2d. What kinds will grow best as standard trees, and what are the best adapted for the field cultivation on the Bengal plan?

6. It is with a view to decide the above questions that I wish to continue the subject brought forward by Mr. Shakespear. I was before aware of the system of cultivation pursued in Bengal so far as it is published in a work considered as authority "On the Husbandry and Commerce of Bengal," but as there are some crude notions abroad in this Presidency on the subject of mulberry cultivation, a decision of these questions from competent authority and experience may prevent much waste of time and capital.

BENGAL CULTIVATION AS DESCRIBED BY MR. SHAKESPEAR.

7. The Indian mulberry plant is not allowed to rise above a foot and a half or two feet. It is cut twice a day as required to feed the worms. The plant is thus exhausted in about the third year, and it is then rooted out, but is easily renewed by cuttings, and planted in rows with just room enough between to admit of the cultivator weeding, dressing, and earthing up the roots.

EXPERIMENTAL CULTIVATION IN WESTERN INDIA.

The mode introduced at Darwar and Poona about ten years since differs but little from that described opposite. The mulberry cuttings are allowed to grow about three or four feet high, and as they are always irrigated, they produce leaves at this height. They are not rooted out under seven years. I am myself convinced that the more frequently this kind of mulberry is cut down, the better and more tender leaves are produced, and that old trees become straggling, and produce inferior leaves. But my experience only amounting to four years, during which time I have cultivated the plant at Dapooree, my authority may be thought insufficient. I therefore beg to submit the proposed Deccan plan for an opinion from Bengal.

Plantations of mulberries, dasee, and perhaps also the bedasee, are now forming about Poona and Ahmednuggur upon the (2) Italian plan, the cuttings having struck, are transplanted, and set from 8 to 12 feet apart, and trained up as standard trees, the leaves of which it is proposed not to gather for four years.

8. The following information is desired from Bengal.

1st. Has such a plan ever been tried in the Bengal provinces, and, if it has, with what success?

2d. Will the leaves be improved or otherwise, as food for the worms, in this climate, by being produced from old trees?

3d. Provided the trees and the leaves be improved by age, and produce a larger crop as they grow older, still will it be possible with any supposable rate of profit to compensate for the capital of a silk farm lying dead for four years, and in a country where labour is dearer than in Bengal *and irrigation* necessary? I have to remark with regard to the two varieties of white mulberry before mentioned, that they are of much slower growth than the common kind, and will probably make good standard trees. They do not so readily root from cuttings. I have found budding them on the common mulberry the most eligible way of propagating them, as a single bud inserted into a stock serves the purpose of five or six buds sacrificed for a cutting; besides gaining a year's growth by the age of the stock. This is of course only a temporary expedient to facilitate the quicker introduction of the plant into the country.

I have the honour to be, &c.

(Signed) CHARLES LUSH,

Supt. Botanic Garden, Dapooree.

Dapooree, Poona, 31*st January*, 1833.

GENUS MORUS.

Species that have been cultivated or proposed to be cultivated *for* feeding silk worms.

1. FRUIT ROUNDISH.

1. *Morus nigra.* The common officinal. Black mulberry (not in India?), used in some parts of France and Italy for feeding worms. The only species common in England.

2. FRUIT CYLINDRICAL.

A. Fruit very long.

2. *Morus latifolia.* Leaves *rough*, variously divided. A large tree common in gardens in the Deccan. The worms do not flourish on it.

B. Fruit short.

3. *Morus Indica.* Leaves *smooth*, entire, or divided, heart-shaped, *equal* at the base; fruit deep purple; stem shrubby and diffuse.

VAR. DASEE.

2. *Bedasee.* (Is this *morus Tartarica* of some Botanists?)

4. *Morus alba.* Leaves *smooth*, entire, or divided, heart-shaped, *unequal* at the base; fruit whitish or *variously coloured*, pink or purple; stem *arborescent varieties;* common simple leaved white mulberry.

2. "DOPIA FOGLIA."

The above varieties differ in the form of the leaves. There appear to be others depending on the colour of the fruit.

The cause of the confusion that exists in the nomenclature of species and varieties of this genus, may be traced to the circumstance of Botanists having taken their characters almost exclusively from the leaves. Now it happens that, in those species which have not been cultivated for fruit or leaves as the *Morus Mauritiuna M. Scandens** and perhaps also in the M. latifolia, the character of the leaf is sufficiently marked to determine the

* Both those are growing in the Botanical Garden, Calcutta, and at Dapooree.

species, while in those kinds of mulberry on which silk worms are fed, an almost endless variety of leaf may be found. This being the case, it becomes of importance that characters should be taken from the fruit, stem, stipula, or parts of the plant. To do this properly every known variety must be procured for comparison, a task which can scarcely be completed satisfactorily by any individual in India.*

The following are the replies of J. M. De Verinne, to the queries submitted by Dr. Leish to this Government.

5th Par. of Dr. Leish's letter.—There are two important points yet to be established with regard to the several kinds of mulberry.

1. What kinds do the worms prefer?

2. What kinds will grow best as standard trees?

2. Cont. What are the best adapted for the cultivation on the Bengal plan?

8th. Par. of Dr. Leish's letter.

1. Has such a plan ever been tried in the Bengal Provinces, and, if it has, with what success? This relates to the plantation of mulberry now forming at Poona and Ahmednuggur upon the Italian plan.

2. Will the leaves be improved or otherwise, as food for the worms in this country, by being produced from old trees?

3. Provided the leaves and the trees be improved by age, and produce a larger crop as they grow older, still will it be possible with any supposable rate of profit to compensate for the capital of a silk farm lying dead for four years, and in a country where labour is dearer than in Bengal, and irrigation is necessary?

The kind with the small leaf of a dark colour, rather thick, called double leaf, more difficult to pick and has been found to be the best cultivated for the nutrition of silk worms in Italy.

Species Morus alba.

Both the species called Morus alba, of a white berry, and the Morus nigra, of a black berry, with upright large trunks, dividing into large branchy very spreading heads rising twenty feet high and more—further valuable information on this subject may be gained by a reference to the "Treatise of Monsr. L'Abbé Boissier de Sauvages, de la Société Royale des Sciences de Montpellier, de L'Académie Impériale Physico-Botanique et de celles des George Fili de Florence," for the treatment of standard trees refer to pages 35 to 54 inclusive.

I think the common "Dasee" Morus Indica is the best adapted for the cultivation on the Bengal plan, (as described by Mr. Shakespear) which is pretty nearly the same all over Bengal; in some places however they strip the leaves off the stems instead of cutting both together.

I cannot say whether it has ever been tried in Bengal.

In Europe old mulberry trees produce better leaves than young trees, and as the trees grow older, the leaves diminish in size and improve materially, so that they at last attain a very excellent quality, and I should think the same effect would be produced here.

3. On referring to pages 349 to 361 inclusive, of Dandolo's Treatise, this question will be found, in a great measure, to be satisfactorily answered, and will apply equally to this country, as it does to the one where it was written.

The St. Helena silk worm eggs, mentioned in the 2d par. of Dr. Leish's letter, were received by me in November last, reared and hatched in January and February last; spun their cocoons, became moths, and laid their eggs; which eggs have again hatched, the beginning of this month, and will give a second crop. The worms were fed entirely on the common "dasee" Morus Indica, introduced by me on the farm, and planted and cultivated on the Bengal method. If I could procure some cuttings of the Morus alba, I would give them a fair trial here as standards according to the best methods adopted on the continent.

It is astonishing to observe that no advantage is taken of the wide field open in this country for the improvement in the cultivation of the mulberry tree, more especially the species which is known to be the best adapted for the food of the silk worm either as standards, half-standards, dwarf-standards, or shrubs, and the breeding and rearing of silk worms by those who are properly acquainted with the minutiæ of this particular study, and the fact is, that those who do really understand it, do not meet with the proper support and encouragement they require, and when this is wanting, no material improvement will ever take place in this branch of Indian commerce.

Mr. Storm states that there are four kinds of mulberry used for feeding the silk worm in the districts adjoining Calcutta.

The native names are, saw, bhore, dasee, and China.

The two first produce fruit (black), but the last two have no fruit. The leaves of the saw are very large, but they are not given to the worm till they have passed two goomes.

The leaf of the bhore is small and jagged.

The leaf of the dasee is small and plain, and the China leaf is also small, but jagged at the stem.

The leaves are considered all equally good for feeding the worm.

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* The lately published volume of Dr. Lardner's Cabinet Cyclopædia "on the culture and manufacture of Silk," is full of loose statements and contradictions regarding the species used in India, China, &c. The inference is that very little is accurately known on this subject.

The mulberry tree is not cut down for 5 years. It is then allowed to grow for 5 years more, when it is rooted out."

Another communication is

ON THE SILKS OF ASSAM, BY CAPT. JENKINS.

Muneeram gives me the following account of the silk of Assam :—

The worm that gives the common fawn-coloured moonga silk when fed on the most common plants, gives a whitish silk when fed on the leaves of other trees : the plants it feeds upon are named and estimated as follows :—

No. 1. *Champa.**—The silk produced from the worm feeding on this plant gives the finest and whitest silk, used only by the Rajahs and great people, and is called *Champa pattea moonga.*

The thread from 11 to 12 Rupees a seer.

No. 2. *Maizankurry,*† called also *Addakurry.*—The leaves of this tree also give a white silk and is called *Maizankurry moonga,* the old trees are cut down, and the jungle about burnt, and the worms are fed upon the tender leaves of the off shoots for one year, when the leaves become too old and hard for the worm.

Silk from 6 to 7 Rupees a seer.

No. 3. *Soom.*‡—This is the common tree in this vicinity : the silk from the worms fed on this give the finest sort of fawn-coloured moonga.

Silk $3\frac{1}{2}$ to 4 Rupees per seer.

No. 4. *Soahalloo.*§—This is also a brown silk of inferior quality. This plant is most common in Dhurumpore and about Russachokey.

No. 5. *Digluttee.*‖—Ditto ditto, but the worms fed on the leaves of this tree increase much in size.

The moonga worm gives broods five times a year, and the cocoon is very large, but thin.

Weight from 5 to 6 grains.

No. 6. *Pattee hoonda.*¶—I could only obtain silk the produce of worms feeding on Nos. 3 and 4, and manufactured into cheap cloths for the lower classes.

The ara or area pat is the produce of another worm and very inferior in appearance to that of the other ; though I believe it is equally lasting ; the worms are fed in the houses and entirely upon the leaves of the arund (castor oil plant), if they are procurable, and if not, on other trees in the order following :—

GREEN RED.

1. *The Ricinus* communis or viridis—v. is a misnomer of Wild : s.
2. *Kisseroo,* a plant I know not as yet.
3. *Rengala aloo,* a common plant, divided leaves like that of the papeeah. I know not its name as yet.
3. *Iatropha manihot.*
4. *The common bair,* Zizyphus Jujuba.
5. *Keora kaura.**—This I know not.
6. *Gooluncha phool,* Assamese name, the Bengalee *Bherondo,* Iatropha curcas.

This worm produces broods every month or every month and a half; its cocoon is much less than that of the foregoing. It is smaller in size considerably, but thicker, only about a grain lighter. The chuddurs made of this silk are thick and very warm and lasting.

Weight from 4 to 5 grains each.

N. B. This worm and its produce is noticed by Dr. Buchanan in his account of Dinagepore; vide Asiatic Journal.

Besides these worms they have in Assam the true silk worm which is fed on mulberries.

This silk is from 6 to 8 Rs. a seer according to qualities."

We derive additional information from the following extract from the Calcutta Daily Commercial Advertiser.

" We have much pleasure in answering the call made on us by Mr. Gaisford, in his interesting letter on silk, in another column. After making every enquiry in our power, we have no hesitation in recommending the immediate adoption of the plan suggested, of raising a capital of Rupees 30,000 for the purpose of forming plantations of the mulberry, and establishments for reeling silk in the neighbourhood of Yewla (Ahmednuggur). It will be observed that Mr. Gaisford recommends the tree cultivation, and the Chinese reel.—Of the propriety of the latter, in that district, we have no doubt, considering that the supply is for native markets, in which they are accustomed to the quality of silk and length of skein, which the Chinese reeling produces. Of the sufficiency of the capital also we are satisfied, since Signor Mutti informs us that he believes the amount proposed would even be sufficient for an establishment embracing his own system of reeling, on an ample scale, which of course would require a greater outlay for buildings and reels than the plan of

* Michelia.

† Perhaps of the Laurel family, looks marvellously like a willow, though it is most probably not of that genus.

‡ A species of Tetranthera or Laurus.

§ Tetranthera macrophylla.—*Rox.*

‖ A plant of the Laurel tribe belonging to Tetranthera. Hamilton calls it Tetranthera diglottica.—W.

Much the same *(quality of the silk)* as the foregoing.

¶ Laurus obtusifolia.—*Rox.* W.

* Sapim schiferum. It would be S. bacchatum, if it were not for the glands on the leaves.—W.

Mr. Gaisford. We hope this gentleman will lose no time in following up the proposal with a full prospectus, and for a want of a better agency we shall, pro tempore, be most happy to receive proposals for joining this undertaking. It is likely that this will be only the forerunner of other establishments formed on similar principles. —There must be many spots of waste about Ghats and in this neighbourhood where, if *merassee* and other claims could be purchased out, and compounded for with the sanction of government, we should in a few years see a manifest improvement in the resources of the immediate neighbourhood of the presidency. In such places, Mr. Mutti's plan altogether, for the export trade, would probably be the favorite, i. e. trees, with the Italian reel. Mr. M. has lately brought some very fine silk from Kutroor, in quality considerably above "Tsatlee"; but when his own account of his progress appears in print, we shall be the better able to judge. In the mean time he informs us that he has made a calculation by weight of the produce of his St. Helena trees as compared with the Bengal field planting. The same quantity of land (an acre), which produces sixteen seers pucka or 32lbs. of leaves per annum, will, if cultivated with trees, produce 71 pucka seers or 142lbs. commencing from the 5th year, and for many years progressively increasing. This result we consider sufficiently important, not merely to induce persons on our side of India to plant the standard tree, but to awaken the silk growers of Bengal to the necessity of experimenting on this subject.

We shall anxiously await Mr. Gaisford's detail of the plan, and the prospectus of the first joint-stock purse proposed for agricultural improvement.—*Courier, January* 21.

TO THE EDITOR OF THE BOMBAY COURIER.

Sir,—Some years have now elapsed since the commencement of attempts to introduce silk cultivation in the Deccan. These attempts have in no case been prosecuted under favourable circumstances, the Poona experiments having until lately been retarded by a conflict of opinions and unfortunate occurrences, and those at Ahmednuggur, by want of practical knowledge, and the proprietor's unavoidable absence from the country. Still they have abundantly proved, not only the capability of the country to produce this important article of commerce, but its superiority over many of those where it has long been a source of wealth to the people.

Various species of mulberry grow with wonderful rapidity and luxuriance. The white standard tree thrives better than in the richest silk countries of Europe; and in four or five years is fit to afford sustenance to the worm, by which time it has attained such size as to be little liable to injury, and independent of all but the most moderate attention and expense.

The climate is eminently suited to the silkworm which spins at all seasons; passes through its metamorphoses more rapidly than in the South of Europe; requires no costly buildings for its protection, and no artificially regulated temperature.

The price of labour is very low, and that kind required for the manipulation of silk might be performed at their own homes by the women and children, whose manual dexterity and delicacy of touch especially adapt them for it.

All this has been repeatedly brought forward, and most fully by Dr. A. Graham in his treatise on the amelioration of India, and all who have had opportunity of forming a judgment, are agreed on the superior qualifications of the Deccan in the above particulars.

Still nothing is done. Year after year is permitted to pass, leaving all these advantages unimproved. Vast tracts of country remain waste. A multitude of people are almost starving in idleness, and silk is all the while largely imported into the very parts which are so capable of supplying the demand of local manufactures, and exporting the raw material for our own in England.

The government, it would appear, can do nothing except wish well, and give some slight encouragement, to the individuals who make a commencement. Officers are the servants of government, and cannot enter into these pursuits. From the natives nothing can be expected: the wealthy saokar will not embark capital in an enterprize unsuited to his habits, and, if he is in any way connected with the China trade, prejudicial to his interest:—to hope anything from the miserable cultivator, is futile.

Is then the introduction of so important a product to be left to the weak efforts of two or three individuals, who, if successful amid their present difficulties, can only derive a small, and slowly wending, and scarcely observable rill from a source which a single vigorous effort might open at once, and effectually to the whole country; for its benefits once palpably set forth, this branch of trade would rapidly ramify and extend through the length and breadth of the land.

I say then, let a Company be formed. Leaving all considerations of interest out of the question, there are well-wishers enough of the people to fill the list of shareholders.

30,000 Rupees, in three hundred shares of 100 each, would be sufficient capital. Details of management may be easily arranged, and there is a vast extent of waste land on the banks of the various rivers and streams of the Deccan.

Instance the neighbourhood of Phoontamba, on the Godavery, as excellently adapted to the purpose. The supply of water is inexhaustible. Very simple machinery would raise it in copious streams from the bed of the river. The ruined streets of the town afford any required quantity of building materials ready to hand. Yewla, the greatest manufactory of silks on this side of India, lies within 15 miles, and is celebrated for the beauty and durability of its dyes.

Government, which has shewn so much liberality in the encouragement of sugar and cotton, would doubtless grant the land on most favourable terms; and we have for our successful guidance the experience of those who have felled the way before us—So I pray you, Mr. Editor, stir the good people up.

I am, &c.
T. GAISFORD.

Patoda Jungles, Jan. 12, 1837.

Art. III.—Journal of the Asiatic Society of Bengal, edited by the Secretary, December, 1836.

This is the completion of the fifth annual volume, edited by our talented friend James Prinsep. Esq. While there is scarcely a task more difficult of execution and more meritorious in its object, than that of conveying to posterity discoveries in science and the progress of oriental literature and researches, there is scarcely one less noticed or supported by the generality of mankind. Nothing can be more striking than the support the worthy and esteemed editor of the *Asiatic Journal* has experienced as the result of his valuable labours, not only have they been performed gratuitously, but he has been actually minus of some thousands of rupees. We are glad therefore to find him increasing the amount of subscription to his work, and we are satisfied that they who duly estimate the value of his efforts will rejoice that he has done so, and endeavour to remove a burthen which should never have been imposed: the numbers published monthly have been enlarged from 62 to 80 pages; the increased rates of subscription therefore, which is only eight annas per mensem, is not proportionate to the value received. We hope that our allusion to the subject will multiply the number of subscribers to this ably conducted work. We turn however from pecuniary considerations to a field of matter before us. An article ON SPECIMENS OF THE SOIL AND SALT OF SAMAR, COLLECTED BY LIEUT. CONOLLY, AND ANALYZED BY MR. STEVENSON, is important. The following is the analysis, accompanied with the editor's remarks.

EXAMINATION OF SELECTED SPECIMENS OF THE SOIL.

BY J. STEPHENSON.

A No. 1.—*Mud from the bed of Sumbhur Lake.*

An average portion digested in distilled water, and the filtered solution (which appeared of a reddish brown colour), subjected to the usual tests, gave the following results.

Nitrate of barytes,.. Copious white precipitate.
Nitiate of silver,.... Ditto flambent grey ditto
Prussiate of potash,.. No change.
Oxalate of ammonia. Ditto ditto.
Litmus paper,..... Ditto ditto.
Turmeric ditto,.... Ditto ditto.

300 grains exposed to a gentle heat in order to drive off the moisture lost 107=35, 6 per cent.

100 grains of the dry mud were now put into solution, and the insoluble matter collected on the filter, washed, dried, and weighed, gave 70 grains.

The filtered solution treated with nitrate of barytes threw down a precipitate of sulphate of barytes, together with the colouring matter, which, after washing, drying, and weighing, gave 17 grains= 10.4 sulphate of soda.

The solution now freed from the sulphate was next treated with nitrate of silver, from which a precipitate of muriate of silver was obtained, weighing 42 grains = 19.5 muriate of soda.

Insoluble matter,..........	70	0
Sulphate of soda,..........	10	4
Muriate of soda,..........	19	5
Loss....................	0	1
	100	0

EXAMINATION OF THE INSOLUBLE MATTER FROM A NO. 1, AFTER THE SEPARATION, AS ABOVE, OF THE SULPHATES AND MURIATES.

Fifty grains of the insoluble earthy matter now freed from the extraneous salts was treated with muriatic acid. A strong effervescence took place, and the digestion was continued for 12 hours, as there was reason to suppose that carbonate of lime was present. It was now repeatedly washed with pure water, and

the remaining earthy matter, which the acid had not dissolved, separated, and collected on the filter, well dried and weighed: it amounted to 37 grains.

The muriatic solution was now treated with oxalate of ammonia, which threw down a copious precipitate of oxalate of lime. This being well washed, and dried, weighed 11 grains = 8.6 carbonate of lime.

The remaining solution contained a considerable portion of loose muriatic acid, which being neutralized with pure liquid ammonia, a portion of alumina (tinged with yellow oxide of iron) was precipitated. This being separated by the filter, washed, dried, and weighed, gave 4 grains.

Calculating then for per centage, the composition of this earthy matter will stand as follows:

Matter insoluble in muriatic acid (silica,)......................	74	0
Carbonate of lime, ...	17	2
Alumina and oxide of iron, ..	8	0
Loss, ...	0	8
	100	0

A No. 10.—This I found to be chiefly composed of sulphate of soda, with the carbonate and muriate of soda in considerable proportion.

A No. 15.—This gave a trace of sulphate; otherwise good salt; though the crystals are small.

A No. 22.—When tested gave traces of sulphate.

A No. 24.—Crystals of a pink colour, which disappear in the filtered solution; the colouring matter appears to be volatile—sulphate of soda predominates in this sample; no carbonate of soda present.

B No. 1. *from an old deep re-opened after* 100 *years. Examination by tests.*

Nitrate of silver,....	Copious precipitate.
Nitrate of barytes,..	Very copious ditto.
Oxalate of ammonia,	No change.
Prussiate of potash,	Ditto ditto.
Litmus paper, ...	Ditto ditto.
Turmeric ditto,....	Ditto ditto.

A fair average sample was taken through the whole thickness of the lump.

100 grains exposed to a gentle heat lost 5.5 grains moisture.

100 grains treated with nitrate of barytes gave a precipitate, which, after having been well washed and dried, weighed 136 = 83 sulphate of soda.

The filtered solution treated with nitrate of silver produced a precipitate of chloride of silver, which, after having been well washed and dried, weighed 22 grains = 10.4 muriate of soda.

The composition of this sample is then as follows:

Insoluble matter, ...	1	0
Moisture, ...	5	5
Sulphate of soda, (and carbonate?)	83	0
Muriate of soda, ...	10	4
Loss, ...	0	1
	100	0

A No. 6.—The salt of which got mixed with scum while forming, appeared very wet.

When tested, this sample appeared to contain a considerable portion of alkali, especially the reddish coloured part called *scum* in the list.

100 grains dissolved, and the insoluble matter separated by the filter, washed and dried, gave 2 grains.

To the filtered solution was added acetic acid till the alkali became neutralized; after which it was treated with nitrate of barytes; the sulphate of barytes was precipitated, and having been well washed and dried, weighed 84 grains = 51 sulphate of soda.

Nitrate of silver threw down a precipitate of chloride of silver that weighed (after washing and drying) 30 grains = 14 muriate of soda.

In order to ascertain the quantity of alkali in this sample, 100 grains were dissolved in pure water, and treated (drop by drop) with sulphuric acid of specific gravity 1. 116 till the exact point of saturation was ascertained, by frequently testing with litmus paper. Towards the point of saturation a strong effervescence took place. The solution was neutralized after 96 grains of the acid test liquor had been used, which is equal to 10 per cent. of carbonate of soda.

This sample being very wet, the moisture was ascertained in the usual way, and amounted to 23 per cent.

This sample, or rather what is called *scum* in the list, is composed of

Sulphate of soda,..........	51	0
Muriate of soda,..	14	0
Carbonate of soda,.........	10	0
Insoluble matter,..........	2	0
Moisture,................	23	0
	100	0

Samples A Nos. 25 and 26, called good and superior salt in the list, when tested, gave traces of sulphate; with this exception the crystals are good and pure.

The conclusions to be drawn from the preceding details are somewhat at variance with the general impression regarding the *Sambhur* salt lakes. At least my own idea, derived from conversation with natives engaged in the salt traffic, was, that the lake water was a deep saturated brine, which left so thick a cake of salt on evaporation in the hot weather, that it was cut out in blocks on the margin and brought away on bullocks.

It would seem, however, that the shallow lake or inundation, would of itself leave a deposit too thin to be profitably worked; and that it is customary to dig reservoirs or *kiyárs* wherein several feet depth of water, already nearly concentrated to brine, are allowed to deposit their crystals on drying; or the evaporation is aided by the introduction of sticks, up which the saline incrustation rapidly creeps.

The velocity of the spontaneous evaporation under the fierce sun and scorching winds of the western desert, is well exemplified by specimens A 15, the *bacheh* or infant crystals of one day's growth, through 16, 17, 18, to 19, the 8th day's produce; in the last the crystals are cubes of full half an inch base. Again we find crystals of the same size in No. 22, from the evaporation of 8 out of 12 fingers' depth of water in 20 days of the hottest season. In No. 23 the crystals from 6 inches depth of water are of ¾ inch base. The *size*, however, of the crystals depends greatly upon the undisturbed continuation of the process, and does not give us a clue to the quantity of salt deposited from a given depth of water, whence we might calculate the saltness of the lake itself at various periods of the season. The rate of evaporation itself may be estimated from the above data tolerably well; thus—"6 fingers in 8 days"—"12 fingers in 20 days"—will be nearly *half an inch in depth per diem!* The pits dug for the reception of the brine seem sometimes to be very deep, 10 or 12 feet; in these when deserted the deposit proceeds for several years, forming solid strata of salt separated by a streak of earth washed in during the rainy season. The accumulation is then dug out in mass: but in general the salt for sale is collected as it forms in the brine pits in a granular state, by which means it is freed from the more soluble salts with which it is accompanied. The *pakká* salt of the *byopárís* or traders (Nos. 25, 26), is of a large grain,—the latter indeed in half-inch crystals,—and not very clean.

A circumstance of chief importance elicited by Lieut. Conolly's specimens, is the presence of the carbonate and sulphate of soda in considerable abundance among the saline products of the *Sambhur* lake. The greater part of the substance described by the manufacturers as *refuse* or scum, which is stated to be thrown away as useless, turns out on analysis to be carbonate of soda, contaminated with sulphate and muriate; and it is well deserving of inquiry, whether the discovery of so extensive a store of *natron* in a state of great purity, may not be turned to profitable account. In all the strata cut from the neglected *kiyárs* the carbonate is seen overlying the mixed sulphate and muriate, of an efflorescent snowy consistence. Sometimes the formation of the salt is prevented by its abundance (as in A 4, 5, 6); No. 5 I find on analysis to contain 40 per cent. of carbonate, with 30 of each of the other salts—and a little care in separating the crystals of these would leave it nearly pure.

Spicular crystals resembling nitre are seen in some of the specimens (A 1 1); they bear a very small proportion to the general mass. It is but necessary to refer to Mr. Stephenson's examination of other specimens, to form a clear idea of the conditions best suited for the separation and collection of the different salts; thus in the old deserted pits (B No. 1), the sulphate is obtained nearly pure; in A 6, 10, it is mixed with carbonate; in A 5, the latter predominates. As for the muriate, from its inferior solubility, this salt is readily separated in a state of purity from the brine.

The small proportion of lime in the earthy residue of A 1, from the bed of the lake, rather militates against the expectation entertained by Lieutenant Conolly from native report, of a subjacent stratum of this mineral.

The points now wanted to complete Lieutenant Conolly's description of the *Sambhur* salt manufacture, and the questions naturally induced from the information he has already given, are:

1. A topographical account of the lakes, their extent, general depth, position relatively to adjacent plains, sands, or hills.
2. The extent of the manufacture, produce, possible increase, price, and other statistical data.
3. Whether the carbonate and sulphate are worked and used? the quantity and price of these.
4. The exact process followed by the native manufacturers or collectors.
5. The specific gravity of the water, both of the lake and of the brine pits, at different seasons; which may be found in the absence of the means of determining it on the spot, by bottling off a portion at stated times. This would also enable us to ascertain whether the carbonate existed in the water, or whether it was formed during the evaporation, by the action of the lime or other earths. The presence of magnesia, of potash, and of iodine, also remains an undecided point, as well as the nature of the pink or amethystine colouring matter remarked in some of the specimens (A No. 24).

To conclude this hasty note. I may mention that I have found M. Gay Lussac's alkalimeter a very convenient instrument for examining these mixed salts. By preparing three standard bottles of dilute nitric acid, nitrate of barytes, and nitrate of silver, adapted to his centesimally-divided dropping glass, the per centage of carbonate, sulphate, and muriate, is obtained successively from the same specimen with great ease and rapidity."

Another valuable paper is from Mr. Griffith, on a COLLECTION OF PLANTS FROM UPPER ASSAM.

The plants collected amount to about 1500, which may be considered about one-fourth of the Flora. The portion of Assam seen by Mr. Griffith may be compared to an extensive plain, intersected in various manners by belts of jungle, the breadth of which is not very great, and towards the eastern boundary the spots unoccupied by jungle become fewer and less spacious. Between *Kujoo Ghat* on the *Noa Dehing*, and *Nungroo* on the *Booree Dehing*, and in the whole of that direction, the country is occupied with jungle. Mr. Griffith's collection was

almost entirely formed at *Sadiyá*, a plain intersected by narrow belts of jungle.

" The peculiar feature of *Assam*, especially its lower and central divisions, consists in the vegetation of its churs, or tracts of sand, very often of great extent, which are stretched along the *Burhampootur*. The breadth of these tracts, taken together, is, in some places, from 8 to 10 miles. They may be said to be throughout their whole extent exclusively clothed with dense grass jungle.

Up to *Rungpoor* the eye meets nothing but grasses, and an occasional Bombax, a tree remarkable for its ramification, the branches being nearly approximated in whorls, and forming right angles with the trunk. About *Buggooa Mookh* belts of jungle begin to appear, here and there approaching to the banks of the river. From this place upwards the belts increase in extent and number, and from *Seloni Mookh* just below the confluence of the *Dihong* with the *Burhampootur* to *Sadiyá*, they preponderate much over the grassy tracts. Above *Sadiyá* these tracts recommence at least on the northern bank, but they disappear soon entirely: the grasses that clothe the churs are, especially throughout Lower and Central *Assam*, of gigantic size, some of them often measuring 20 feet in height. They consist of four or five species of Saccharum, the kuggra, mog, (white,) molaha, (red) and telee, (blackish,) of the Assamese, and a species of Arundo, which is perhaps the longest of all, the nul (or podomolee*) of the natives. Towards *Sadiyá*, however, very large tracts are covered with Imperata Cylindrica, the *ooloo-kher* of *Assam*, which grows to the height of 5 to 7 feet. As the genus Saccharum far preponderates over the others, and is perhaps during its inflorescence one of the most conspicuous genera of the order, the appearance presented by the churs during the flowering of their occupants, can be more easily conceived than described.

It may perhaps be convenient to consider the botany of *Assam* under the following heads.

I. Botany of the *Burhampootur*, including the churs.

Of these, Gramineæ form, as I have said, almost exclusively the Flora. Of the immediate banks, the predominant order is,—Compositæ, Polygoneæ, Scrophularineæ, Gramineæ, (among which is a species of Alopecurus,) Boragineæ, have several representatives from *Jorhath* upwards to *Diboroo Mookh*, a large annual Ranunculus occurs extensively, and throughout the same distance large patches not uncommonly occur of a species of Irematodon,, (I. *sabulosus, mihi.)* a species of Polentilla is also not uncommonly met with.

II. Botany of the plains.

Predominant plants, Gramineæ; of these the most common about *Sadiyá* are Imperata cylindrica, Saccharum spontaneum, Saccharum fuscum (Roxb.) in wet places, and a probably new, large, and coarse species of Panicum. Among these may be found two or three Orchideæ, Polygoneæ, Leguminosæ, Cyperaceæ, one Viola, and a species of Exacum which is particularly conspicuous from its bright blue flowers.

Those parts of the plains which have at a previous period been cleared for cultivation, but are now unoccupied, present the usual tropical features; and are occupied chiefly by Cyperaceæ, among which occur one or two Gramineæ, several annual Scrophularineæ, and small Alismaceæ.

III. Botany of the belts of jungle. *

IV. Botany of the foot of the boundary hills.

On this last I am not able to offer any remarks. It will be found excessively rich in ferns, and next to these perhaps in Cyrthandraceæ. The only opportunity that has hitherto been allowed me of visiting any portion of these boundaries above *Gowahatti*, occurred at *Gubroo Purbut*; and I was then fortunate enough to meet with an Alsophila 30 feet high, a Sollvana, (mihi.) and Kaulfussia Asamica. Of the third division, the botany is very varied; so much so, that no one prominent feature seems to present itself. It is to this section that by far the greater number of species contained in the collection will be found to belong; and I shall hence pass in review the orders composing it—reserving the few observations I have to make on the most interesting plants to a subsequent part of this paper.

To those orders, the presence of which indicates the climate of northern latitudes, or of a tropical one at considerable elevations, I have appended an asterisk; and to those which, though usually tropical, include plants which have hitherto only been found at comparatively high elevations, I have appended a cross.

DICOTYLEDONES.

* Ranunculaceæ,	3
* Magnoliaceæ,	1
Anonaceæ,	6
* Umbelliferæ,	7
Araliaceæ,	3
Ampelideæ,	15
Onagrariæ,	1
Loranthaceæ,	1
Alangieæ,	1
Melastomaceæ,	5
Memecyleæ,	3
Myrtaceæ,	4
Cucurbitaceæ,	12
Begoniaceæ,	1
* Cruciferæ,	3
Capparideæ,	3
* Violarieæ,	2
Guttiferæ,	2
* Temstræmiaceæ,	3
Sapindaceæ,	3
* Hippocastaneæ,	1
Herculiaceæ,	1
Bythneriaceæ,	1
Malvaceæ,	4
Dipterocarpeæ,	2
Tiliaceæ,	5
Elæocarpeæ,	1
Lythrarieæ,	1
Meliaceæ,	8
Aurantiaceæ,	7
Rhamneæ,	5
Euphorbiaceæ,	16

* See BUCHANAN'S *Dinájpur*, p. 168.—ED.

Hippocrateaceæ,	1
Malpighiaceæ,	2
* Conariæ,	1
Tranthoxyleæ,	5
Balsamineæ,	5
Casyophylleæ,	4
* Rosaceæ,	6
Leguminosæ,	41
Connaraceæ,	2
* Cupuliferæ,	2
Urticeæ,	24
Artocarpeæ,	18
Stilagineæ,	2
* Cloranthеæ,	1
*Saurureæ,	1
Piperaceæ,	5
* Thymeleæ,	1
Proteaceæ,	1
Laurineæ,	6
Amaranthaceæ,	5
† Polygoneæ,	12
† Menispermeæ,	19
* Primulaceæ,	1
Myrsineæ,	6
Styraceæ,	3
Convolvulaceæ,	6
Rubiaceæ,	36
Lobeliaceæ,	1
* Campanulaceæ,	2
* Sambuceæ,	1
* Viburneæ,	2
Cyrthandraceæ,	7
Verbenaceæ,	11
Labiatæ,	14
Acanthaceæ,	8
Scrophularineæ,	20
Orobancheæ,	1
Compositæ,	39
* Plantagineæ,	1
* Gentianeæ,	1
Apocyneæ,	8
Asclepiadeæ,	9
Oleinæ,	5
Jasmineæ,	2
* Boragineæ,	3
Cordiaceæ,	1
Ehretiaceæ,	4
Solaneæ,	6
Gnetaceæ,	1
Incertæ sedis, including Roydsia,	31
Total,	523

MONOCOTYLEDONES.

Scitamineæ,	9
Canneæ,	1
Hypoxideæ,	1
Amaryllideæ,	1
Hydrocharideæ	1
Aroideæ,	3
†Smilaceæ,	7
Dioscoreiæ,	2
Podostemeæ,	2
*Orchideæ,	15
Potamogeton,	1
* Junceæ,	2
Palmæ,	3
Tupistra,	1
† Butomeæ,	1
Alismaceæ,	10
Eriocauloneæ,	1
Gramineæ,	37
Cyperaceæ,	28
Total,	126

ACOTYLEDONES

Equisetaceæ,	1
Lycopodiaceæ,	5
Filices‡,	34
Total,	40

‡ Chiefly from the foot of the Abor Hills, on the *Dihong*.

Of *Anonaceæ* I shall only notice Sphorostemma, Blume. In this genus the connectivum is highly dilated, and the cells of the anther at a considerable distance from each other; and yet from the *arrangement* of the stamina, bilocular anthers with contiguous loculi result.

It affords another instance of the existence of the peculiar tissue, until lately supposed to be characteristic of Gymnospermæ. In addition to this singularity, its medulla is traversed longitudinally by bundles of dense, occasionally branched, woody fibre, which consists of a superposition or "emboitement" of several layers.

Cucurbitaceæ. Among these plants occur two genera which appear to be new, so far at least as the Prodromus of M. De Candolle is concerned; in which book the article on Cucurbitaceæ (by M. Seringe,) appears to me to be very unsatisfactory. Of one of the above genera, I have only seen the male; it is remarkable for the involute, or rather gyrate involution of the petals. The second I propose calling Actinostemma: it is chiefly remarkable for the complete separation of its stamina; for the "dehiscentia circumcisa" of the fruit; and, above all, for the pendulous direction of the seeds. It approaches in some points to Zanonia. I am not aware whether the peculiar nature of the arillus of this order has been explained or not; it is a separation of that portion of the tissue originally surrounding and in close contact with the ovula. Hence it is a shut sac; and hence, too, it is wanting in Actinostemma, in which the cavity of the ovarium is not filled by a production from the placentæ.

Conariæ. In Conaria, of which I have one species from the Abor Hills, the raphe is certainly external with regard to the axis. I have not been able to ascertain whether this depends upon any torsion of the funiculus, which Mr. Brown has stated to be the case in other instances of a similar anomalous situation.

Of *Saurureae*. Houttuynia is the only example. This plant, which was originally described by Thunberg, appears latterly to have been more misunderstood than by the original describer. I have had no opportunity, however, of examining the work of Thunberg in which the plant is described. And I ought, perhaps, to expect M. Meyer, who has published "De Houttuynia atque Saurureis," with which work I am unacquainted. I find each flower throughout the spike, except perhaps the terminal one, to be subtended by a very small bracte. Of these, the four lowermost, rarely only three, are highly developed and petaloid, forming the spatha.

The number of stamina to each flower is, excepting those at the apex of the spike, almost invariably three, and always equal to the carpella entering into the formation of the female organ; and of these the third is always next the axis. The terminal flower has from five to seven stamina; the space between this and the uppermost triandrous hermaphrodite (?) flowers is occupied by an assemblage of

male flowers, with a variable number of stamina, but never greater than three, and usually, think, two. That such is the structure of this portion is proved by the presence of bractea, similar to those of the lower portion, interspersed among the stamina. Dr. Wallich says, in Flora Indica, I. 362—" In the numerous spadices which I have examined, I have with Father Loureiro invariably found three staminas, and as many styles attached to each ovarium : the former above the base, the latter at the apex of its angles. I have not, therefore, hesitated continuing this most interesting plant in the very class and order where it has been placed in the Flora of Cochinchina. As there is no reason for considering it at all different from the original *Japan* plant, I am at a loss to account for the difficulty which the celebrated Chevalier Thunberg experienced in determining its station in the sexual system ; nor can there be at present any doubt of its neither belonging to Heptandria, Polyandria, or Monæcia." Thunberg was, however, so far as I can see, right ; for he paid, in all probability, exclusive attention to the composition of the terminal flower, on which, in certain cases, the Linnæan rules lay much stress. Taking this into consideration, Houttuynia may be referred to Heptandria, Polyandria, or Monæcia ; most correctly to the latter, and least correctly to Polyandria. But as,—so far at least as regards the Linnæan system,—the most obvious characters are the best, it is advisable to keep the plants still in Triandria Trigynia. The structure of the seed has been likewise totally mistaken. In the Flora Indica, loc. cit. the embryo is placed at the wrong end of the albumen, and is mistaken for the embryonary sac. The real embryo is a much more minute organ contained in this, " the vitellus," or membrane of the amnios of Mr. Brown. Dr. Hooker describes Dr. Wallich's account as most correct ; but he does not define the situation of the embryo otherwise than by saying that it is situated at one end of the seed. Lastly, the plant does not belong to Aroideæ nor even to Monocotyledones. Notwithstanding the apparent solidity of true embryo, yet the more important nature of the structure of the stem is sufficient to point out that it is Decotyledonous, or rather Exogenous ; and among these, its true place is, beyond doubt, Saurureæ.

Of *Thymeleæ* one species only occurs, which is apparently referrible to no published species of the order. To this I have attached the MSS. name of JENKINSIA, in compliment to Captain F. Jenkins, Agent to the Governor General on the North-East Frontier, to whom Botany, among other sciences, is considerably indebted.

Of *Menispermeæ* the majority are interesting. Cissampelos is the only genus with which I am acquainted, in which the ventral suture of the ovarium is anticous, or not next the axis. I am not certain whether the most correct way of understanding the curious structure of the female flowers is not to assume the aggregation of four flowers, which, in the only species I have examined, appears constant, as a complete quaternary division of one only. It remains to be ascertained whether the singular reversion of the situation of the ventral suture is more uncommon in aggregate than in solitary carpella.

Of the genus *Stauntonia*, *Assam* has two species, but only one is contained in my collection. The anomalous structure of the fruit has no doubt been explained by Dr. Wallich in his Tentamen Floræ Nipalensis, in which it is published under the name Holböllia, but which I am at present unable to consult. I find that the placentation of this genus is similar to that of Flacourtianeæ, with which order I am not acquainted, and to that of Rutomeæ ; and hence the anomalous situation of the seeds. At the period of expansion of the flower, the ovula are much less developed than is almost universally the case : they present indeed the appearance of ovula at the earliest stages of development. I refer to this order a plant with long racemes of ternarily aggregate fruits, notwithstanding that it has milky juice, and that the Cotyledons are large, foliaceous, and obliquely situated with regard to each other.

Among the *Cyrthandraceæ* a species occurs, (Chiliandra obovata, mihi,) remarkable for the structure of its mature anthers. These dehisce in a labiate and incompletely bivalvular manner, the lower and smaller valve being alone half reflexed. This valve is compound, and due to the mutual adhesion of the originally distinct inner locellus of each loculus. To this formation I have adverted in a short memoir on Rhizophoreæ, published in the Transactions of the Medical and Physical Society of Calcutta, although I was at the time ignorant of the existence of an example. *Assam* contains another interesting species of this family : this, which is remarkable for its pentangular petaloid calyx, and the " dehiscentia circumcisa," of its fruit, in which it approaches to Aikinia of Mr. Brown, I propose calling Cyananthus.

Scrophularianeæ afford one new genus, (Synphyllium torenioides, mihi,) an account of which will appear in the Journal of the Madras Literary Society, edited by my friend Mr. Cole.

Asclepiadeæ contain some interesting species, of which one constitutes probably a new genus, unless, indeed, it is referrible to Dr. Wight's Heterostemma, from which it would appear to differ in the valvular æstivation of the corolla. This species is remarkable for the aliform processes running along the larger veins of the under surface of the leaves.

To this order, or to Apocyneæ, is to be referred a remarkable plant, distinguished by the numerous longitudinal foliaceous alæ of its follicles, and, I speak from memory, its serrated leaves. This plant, which I have seen near *Mergui* on the *Tenasserim* coast, seems to have been sent by Captain Jenkins to Dr. Wallich, with many others, none of which appear, however, to have excited much attention.

Among the *Boragineæ* we find one Myosotis and a species which, with the habit of some

Anchusæ, appears to be not referrible to any genus of the order. The "umbilicus" occupies the centre of each carpellum, and is surrounded by an osseous elevated margin. The origin of this is totally distinct from that of Myosotis, and is wholly independent of fecundation. The radicle is in addition inferior.

The Monocotyledonous forms are chiefly those of other parts of India. Among the *Orchideæ* two species of Calanthe, and two of Pogonia occur, as well as one species of Spiranthes. Among the Gramineæ the most interesting is a Diandrous species of Alopecurus, which genus is, I believe, new to India; at least to any portion of the plains.

Of the Cyperaceæ, I shall only advert to the existence of four species of Carex, two of which are, however, from the Abor Hills; a third, which was originally sent by Captain Jenkins to Dr. Wallich, appears to be widely distributed, extending from *Gawahati* to *Jorháth*; the fourth I have only met with about *Sadiyá*.

But perhaps the most interesting plants of the whole collection are contained among those "incertæ sedis," a division, always to a beginner, of great extent. Most of these are from the lower ranges of the Abor Hills; and the appearance of these is quite sufficient to ensure their being of great interest."

Art. IV.—Notes on Persia, Tartary, and Afghanistan. By Lieut. Col. Monteith, K. L. S. *of the Madras Engineers.—Madras Journal of Literature and Science,* 1836.

Defence of British India from Russian Invasion. By Captain C. F. Head, *Queen's Royal Regiment.*

(Continued from page 428.*)*

Captain Head is of opinion that, if any difficulty exists of an army accomplishing the march to which we have alluded, it would be in crossing a bad road from Astrabad, in ascending the mountain pass, and crossing the desert beyond it: but these obstacles might be avoided, if steps were taken at an early season of the year. It must, therefore, be admitted that an army, possessing the resources of the country, might be transplanted from the Caspian Sea to Mushed without any great privation or delay. At Mushed provisions are in general plentiful and reasonable. From the ready communication between this place and the frontier of the Russian empire, a force would have little difficulty in completing the necessary arrangements for pursuing their route from Mushed through the fertile valley that extends the greatest part of the way to Herat. Midway between these places is a large town, called Toorbutejam, the chief place of a fertile and well-peopled district. The only obstacle in this route is a rocky pass which extends for four miles: there is another route between Mushed and Herat, of about 238 miles, by which a Russian force can march from Astrabad to Herat through a country already as practicable as others in the East, and without the probability of any material suffering; and arrive at the latter station by a journey of 610 miles. There are other routes from the Caspian Sea to Herat, which are at all times frequented by caravans trading between Russia and the East.

"The position and resources of Herat have already been adverted to; and to contemplate its occupation by a rival European power, must be a subject for much speculation and alarm. The vicinity of that city to the Indus, and its communication with different places on the banks of that river, by well-known and perfectly practicable roads of no more than between 700 and 800 miles, would produce external and internal agitation, that could not fail to endanger a government organized like that of India. It will be much the safer plan to lay bare the probable consequences of such a contingency, and make preparations to oppose them while there is time to do so. There is less objection to this mode of treating the subject, because timely attention to it and precautionary measures may effectually prevent the attempt of Russia in any endeavour to reach India; whilst a longer neglect of the British Government to establish its influence, if not its power, as far as the banks of the Indus, must accelerate the execution of a project which, in its most favourable termination, would be attended with large and ruinous expense.

The remainder of the distance over which a force would have to pass from Herat to reach the Indus, is included in the kingdom of Cabul."

The city of Candahar is half way from Herat to the Indus. The distance is about 370 miles. The interjacent country is a vast sterile plain, without wood, pasture, corn, or habitation, and in many places destitute of fresh water. Around Candahar, the country is fertile and highly cultivated, the city wealthy and flourishing, and fruit and provisions cheap and abundant. Arrangements

would be required to enable an army to effect this march, but it does not appear there can be any material obstacle to check their advance.

" No tract of country can possess a less portion of the necessaries of life than the Desert between Cosseir and the Nile; and yet that sterile tract was crossed in 1801 by several thousand men of the British army with but a trifling loss; and when arrangements were afterwards matured, a battalion marched over it in June, the most unfavourable month in the year, with the loss of only a boy."

It appears that from Candahar there are different routes by which caravans proceed to India. One to the south crosses the Indus by boats at Meerpoor, which is near the city of Moultan, and is at a distance of 350 miles from Candahar. This presents no obstacle to an advance, and has been pursued by former invaders.

" This is, perhaps, our most vulnerable frontier, and after the passage of the Indus, the nature of the country, which is flat, and abundantly supplied with provisions, offers no serious impediments to the advance of a large body of men." Another route ascends to Cabul, the capital of the Afghan Empire, and passes on to the city of Attock, where the Indus is fordable. This route was used by Alexander, and has been followed by modern conquerors, of whom Sultan Mahmood, with an army of 30,000 infantry and 100,000 cavalry, passed Attock and skirted the mountains of Cashmere, from whence he descended into the plains of Hindoostan.

The route from Candahar to Cabul, by a road of 176 miles, passes over a country in several parts well cultivated and productive. At Cabul provisions are found in considerable quantities. A river, fordable in dry weather, passes this place, skirting the chain of mountains, and falls into the Indus near Attock. The road from Cabul passes through Paishaweer, "a beautiful valley on the Indus. The town of Paishaweer is still of some magnitude, having 100,000 inhabitants."* The distance of this place from Cabul is 180 miles, and from Paishaweer to Attock on the Indus is 50 miles. The vicinity of Attock is the only place where the Indus can be conveniently crossed; here the river is of great breadth, black, rapid, and interspersed with islands, all of which may be easily defended.† Another authority says, " The Indus indeed was forded above the junction (at Attock), by Shauh Shuja and his army, in the end of the winter of 1809; but this was talked of as a miracle wrought in the king's favour; and I never heard of any other ford on the Indus, from the place whence it issues from the mountains to the sea."‡

* Elphinstone.
† Macdonald Kinneir.
‡ Elphinstone.

The route from Candahar to Attock would appear to be 406 miles, and to offer little obstacle to the regular approach of an army. On the east side of the Indus at Attock is the Punjab, or " five waters," from the five celebrated rivers that flow through it. " The climate is exceedingly healthy; and the country is highly cultivated and very populous."* By the information we have been able to collect, the distance from Herat to Attock is 776 miles, and the whole march from the shores of the Caspian to the latter place would be by a route of 1377 miles.

There is nothing either in the nature of the countries to be passed through, or in the disposition of their inhabitants to render this undertaking one of insurmountable difficulty, or of necessary protraction. It ought to be expected whenever the policy of the government of Russia may hold it fit to separate from its friendly alliance with Great Britain. At present the European energies of the British government in India are chiefly confined to the ports of Calcutta, Madras, and Bombay, and other places near the coast. It will suffice at this moment to remark that the principal depôt, above mentioned, of these three, is by the dâk, or post route, 1480 miles from Attock, or a greater distance than a Russian force would require to march to reach the same place. Madras is yet farther from the point of contact than Calcutta. Bombay is nearer the Indus than either of the other Presidencies, but its military establishment is very inferior in numbers. An attempt will be made heareafter to point out, that through the medium of steam navigation on the Ganges, and by the western shore of India and the Indus, effectual steps may be taken to improve the communication with the probable point of contact, to remove, in a great measure, or totally to dispel the danger to be apprehended from any attempt that might be made by Russia to subvert British ascendancy in India."

(To be continued.)

Art. V.—Narrative of a Residence in Koordistan, and on the site of Ancient Nineveh; with Journal of a Voyage down the Tigris to Bagdad, and an Account of a Visit to Shirauz and Persepolis. By the late CLAUDIUS JAMES RICH, ESQ., *the Hon. East India Company's Resident at Bagdad, Author of " an Account of Ancient Babylon."* 2 *Vols. Octavo.* JAMES DUNCAN, *Paternoster-Row,* LONDON, 1836.

(*Continued from page* 430.)

The editor of this work states that the heat for five months at Bagdad is scarcely

* Sir John Malcolm.

paralleled in any part of the world. The natives are obliged in consequence to take refuge in cellars under ground, and at night to sleep on the roofs of their houses, the rooms of the house during that period being uninhabitable. The thermometer generally rises to 115°, in a shady verandah, and it has been seen as as high as 120°, in the middle of the day, and 110° at ten at night. Great are the sufferings from a burning hot wind, smelling strong of sulphur. To escape the great heat of a Bagdad summer Mr. Rich determined to visit the mountains of Koordistan. Another inducement for him to visit these mountains was that they were little known in Europe. Mrs. Rich accompanied the traveller, who was obliged to proceed in his official character: the former was obliged to submit, therefore, to the disagreeable restraint of performing the journey in a covered litter or takht-revan, attended by women servants, and all the state of a haram. Nothing occurs worthy of our notice until Mr. Rich arrives at Kifri, where he found a small community of Jews who had a synagogue. The following is a description of a visit to the ruins of Kara Oghlan.

"About half a mile S. E. of Kifri, in the bed of the torrent, are some appearances of low walls or foundations, which were laid open by the late rains. One of the walls exhibited a piece of plaster of stucco, with ornaments on it. I was anxious to lay open more of the ruins, in order to come at some notion of the design and age of it. By dint of digging we laid open a small room, or rather all that remains standing of it, viz., about four feet high of wall with a door-way; the room is very small, say about twelve feet square; the walls are built of unshapen stones (as at Kasri Shireen), of gypsum covered with plaster, on which are wrought ornaments in compartments. We dug out pieces of plaster, with ornaments of flowers or arabesques painted on them in fresco, the outline being black and filled up with bright red, and the ground being the colour of the plaster; the colours were beautifully fresh. As the sides bore no appearance of painting, I imagine these pieces to be fragments of the ceiling. Some pieces of charcoal were also found. We laid open this room and part of another. This appeared to form part of a range of cells, extending a short way W.S.W. and E.N.E., of which there seem to be traces of five or six: they are in single file. The north side is strengthened with small round buttresses.

East of this, under the hills on the margin of the torrent, (by which its west face has indeed been cut down,) is a very large high mound, of a square figure, from which a quantity of earthen jars have been dug out, some pieces of which were brought to me. They were of coarse earthenware, varnished black in the inside, and perfectly resembled those found at Seleucia and Babylon. I have also a small earthen lamp which was found there. It is like the lamp now used by the villagers.

Gold and silver coins are also frequently found here, which the villlagers immediately melt down. I much regret not having been able to see any one of these, which might have enabled me to form some better general idea of the age of these ruins. The jars or sepulchral urns, however induce me to refer them to the Sassanians. On the top of this mound are traces of building; and all along to the foot of the hills, and up as far as opposite Kifri, are also vestiges of buildings, many of which consist of square basements, something like those at Kasr Shireen and Haoush Kerek, though not standing so high above the soil. The extent of the ruins in length may be a mile; in breadth about a quarter of a mile. We dug in several places, but found nothing. There are also some vestiges of a wall on the western bank of the torrent; and, crossing it diagonally about Kifri, are fragments of immense solid buildings, overthrown by the floods which the peasants suppose to have been a dam across the torrent, but which I rather imagine to be the city wall. The style is just like the other parts of the ruins, of rough stones, strongly cemented together with lime. It is evident, from the remains in the very centre of the torrent, that it could not have flowed in this way when the city existed. Indeed, in all likelihood it was confined, and directed to cultivation.

The inhabitants attribute these works to the Ghiaours, or infidels. What place this really was it would be difficult, from our imperfect knowledge of the Sassanian empire, to say. I doubt its being in any line of the Roman operations against that empire, by which alone we know anything about it.

Farther up the torrent, on the N.N.W., are some excavations in the rock, called Ghiaour houses. Mr. Bellino went to see some of the same kind in the hills, ten minutes' ride from the S. extremity of the ruins. He found excavated sepulchral chambers, with very low doors, and, in the inside, three places to lay out bodies, but they were of small dimensions, about five feet long. The plan of these excavations resembled the Achæmenian sepulchres at Nakshi Rustam; but there was no writing or carving of any description about them. Farther on, about three miles from the ruins, on the top of a hill, are some vestiges of building, which the people call Kiz Kalasi, or the Girl's Castle. Here urns and bones are found; Mr. Bellino saw one of the former; but the place has nothing else remarkable: it is nearly opposite Oniki Imaum."

Approaching Eski Kifri is an immense artificial mount, like the Mujelibe, with almost perpendicular sides, except where the

rains have made deep cuts or furrows. In one of these furrows a small vault had been discovered; it was of coarse-baked brick, and contained many sepulchral urns, in some of which gold coins were found. In digging, small pieces of human bones were discovered, and fragments of arms, all of which had a black varnish on the inside; but the pottery was of different quality, some coarse and unornamented; others of a finer kind; and the finest, with figures of deer or cows in small circular compartments.

"I had given orders to bring me any coins or other antiques that might be procurable among the peasants here. To-day Reuben brought me, from his Israelitish friends, three coins and a small intaglio: but so far from throwing light upon the age of the neighbouring ruins, they are as if purposely designed to obscure and to confuse one: one being Arsacian; another, Sassanian; the third, Coufic; and the intaglio, a Roman victory."

The following is a curious instance of Turkish tyranny. At a place called Oniki Imam, about fourteen miles from Kifri, in the gypsous chain of hills, there are naphtha springs.

"One small spring was discovered a year ago in the same hills, a few minutes west of Kifri. The peasant who discovered it was seized by the Turkish government, and severely bastinadoed, to make him confess if he had sold any of the naphtha before the discovery became public. In consequence of the persecution which he suffered on account of this unlucky discovery, he was obliged to emigrate with his family into Persia, where he says he is very comfortable. He happened to be here on business, and told me the story himself. "God," said he, "did not allow the Turks to profit by their tyranny; for the spring, which was a very copious one when I discovered it, became dry when I was bastinadoed, and now only yields a few drops of no consequence."

We observe that the Eastern form of flattery exists equally among the people we are now describing as in all parts of Bengal and Hindustan.

"We passed through much cultivation, principally of barley; some portion of which was already ripe, and they were cutting it. The reapers brought us some sheaves, which they threw into the road before my horse, exclaiming, "May your enemies be thus!" and they expected a few paras in return. In the East, everything is seized upon as an occasion for extracting a *bakshish* or present."

Our travellers reach Toozkhoormattee, which is situated close to the gypsous hills of Kifri. On this pass is a well of naphtha and salt; and further south in the hills, is another spring of naphta, but no salt. Mr. Rich reaches the Beiats, and proceeds to view the curiosities of the neighbourhood, the account of which will be better described in the language of the author himself.

"I sallied forth this morning to view the curiosities of the neighbourhood. The naphtha-pit is in the pass of the hills about a mile S.E. of the town; and, being in the bed of the torrent, is sometimes overflowed by it, and, for a time, spoilt, which was the case during the heats last summer. The pit is about fifteen feet deep, and, to the height of ten feet, filled with water; on the surface of which the black oil of naphtha floats, small air-bubbles continually rising to the surface. They skim off the naphtha, and ladle out the water into a channel, which distributes it into a set of oblong, shallow compartments made in the gravel, where they allow it to crystallize, when it bcomes very good salt, of a fine, white, brilliant grain, without any intermixture of bitterness. Great quantities of this are exported into Koordistan; and it is worth annually about 20,000 piastres, which is distributed among the different members of the family of the late Defterdar*. The oil of naphtha is the property of the village. Part of it is consumed by the Menzil Khaneh †, or sold for its support, and part for religious establishments, &c. About two jars, each containing six okas ‡, or one Bagdad batman, of naphtha may be skimmed from this well in twenty-four hours. The spring is at the bottom of the pit or well; and once a year they cleanse the well, on which occasion the whole village turns out; victuals are distributed to all the poor, and sacrifices of sheep are made, to the sound of drums and oboes, in order to insure the good flowing of the spring again—a ceremony, in all probability, derived from remote antiquity. The principal naphtha-springs are in the hills, a considerable distance south of this, towards Kifri. They are five or six in number, and are much more productive than this pit, but no salt is found there. Indeed, it is probable that naphtha may be found in almost any part of this chain. Near the naptha-pit in the hills are alum (zak or sheb) and chalk (tebeshin), of a very fine, close, white grain; but the natives make no use of these productions. An earth is found, which they employ to give an acid flavour to some of their dishes; no doubt it is vitriolic. Sulphur is also found, and is used by the peasants to cure the itch in their cattle and themselves.

* The treasurer of the Porte, father of Omar Bey.

† Post-house.

‡ An oka contains about two and a half English pints.

I now come to a description of the pass itself. It runs nearly E. and W., and resembles that of Kifri in its composition and appearance, though on a larger scale. On the west side of the hill, which faces the plain, the strata are horizontal and parallel. On the north side of the pass they are inclined downwards at an angle of about 45°, and somewhat curved or convex. On the south side of the pass the hills are more more earthy, and have been furrowed and crumbled down by the rains; and in one part some pillars, as it were, of the hill are left detached. The naphtha-pit may, indeed, be said to be situated in these *debris* on the edge of the torrent's bed; gypsum is apparent in every part. On the north side is sandstone; and at the bottom of all, as I saw in an arch or cavern in the very foot of the cliff, is clay-slate, or hardened clay of a blue colour. The determination of the water is all to the north side of the pass, where it has cut down the hills into a precipice or cliff. On the summit of this cliff are the ruined walls of an old castle, the age of which it is difficult to determine: it may be Sassanian. At the foot of this is a little hollow in the rock, containing a naphtha-pit. The top has been arched over with large square blocks of gypsum, and is apparently a very ancient work.

I had forgotten to say, that in the great naphtha-pit is a beam of wood, just above the surface of the water, fixed at both ends into the side of the pit. This wood, they say, is as old as the time of the Ghiaours, and has been preserved by the virtue of the naphtha oil. They also attribute the castle to the Ghiaours*. In the earth about the foot of the castle-hill, near the small naphtha-pit, I saw many stains of a bright yellow, and perceived a strong smell of sulphur. The people consider this cliff as a great preserver of Toozkhoormattee; they say it turns off the torrent and gives it an inclination from the town. On the summit of the hills, on the north side of the pass, overlooking the plain, is a small kumbet or dome, marking the site of some foolish story about Ali. They say, on the eve of Friday, a little lamp is seen to burn of itself there: it is most probably a similar phenomenon to Baba Goorgoor*.

After having finished our observations on the naphtha-pits, we rode round the town by the torrent to the west, to see some ruins, but we found little worthy of observation. A party of peasants were employed in cleansing a canal, to the sound of the *zoorna*, or trumpet, and double drum. The reapers were at work in some places. On the west of the town are some mounds of rubbish, with nothing to characterize them. They may possibly be ancient, as antiques are said to be found here; but I have not yet been able to procure any. On a little square platform of a building is one pier of it standing, of coarse masonry, apparently not very ancient. Farther north, are six piers standing, forming part of an oblong building, whose direction is east and west, and it appears to have been composed of a body and two aisles, or verandahs. The door is west, and another corresponding recess or opening on the east has been supported on each side by a semi-circular pilaster or buttress. The whole has been vaulted; the masonry is extremely rude. I should conjecture this to have been a church; it greatly resembles the ruins of Chaldean and Syrian churches I have seen. The mounds are scattered about to a great extent, and prove this to have been, at some former period, a considerable place. From the principal mound the Hamreen mountains were in sight, in the western horizon; the distance is said to be about nine hours. We could also see plainly where the Karatepéh or Zengabad range strikes off from the Hamreen, and pursues a more easterly direction.'

Here we must part with our interesting travellers for the present. We hope to accompany them in our next.

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* Ghiaour, originally Geber or fire-worshipper, is now synonymous with Kafer, and is applied to the people who preceded the Mahometans, as well as to Europeans.

* Baba Goorgoor is the name given to a spot three miles from Kerkook, where, in a little circular plain, white with naphtha, flames of fire issue from many places. There appears to be little doubt, as D'Anville conjectures, that this is the Korkura of Ptolemy.—See "D'Anville on the Euphrates and Tigris." Quarto edition, p. 103.

Art.—VI. A Tabular View of the Generic Characters in Roxburgh's Flora Indica, compiled by H. Piddington, Esq.

The above has appeared forming an appendix to the Journal of the Asiatic Society for the benefit of travellers. We beg to exhibit them in the following form.

MONANDRIA MONOGYNIA.

GENUS, Canna, *Linn. Schreb.* FLOWER—Style, spatulate; growing to the tube of the corol. Stigma, linear. Anthers, single; attached to the edge of the petal-like filament. FRUCTIFICATION—Capsule, three-celled. Seeds, several; naked.

GENUS, Phrynium, *Willd.* FLOWER—Style, growing to the tube of the corol. Stigma, infundibuliform. Anthers, single; terminal, on a short, erect filament. FRUCTIFICATION—Capsule, three-celled; three-valved. Seeds, solitary; arilled at the base. Embryo, uncinate, and furnished with a perisperm.

GENUS, Hedychium, *Kön.* FLOWER—Anthers, Double; naked. PERIANTH—Corol, with a long, slender tube; both borders three-parted; inner resupinate.

FRUCTIFICATION—Capsule, three-celled; three-valved. Seeds, numerous; arilled. Embryo, simple, with perisperm and vitellus.

GENUS, Kæmpferia, *Linn. Schreb.* FLOWER—Anthers, double, with a two-lobed crest. PERIANTH—Corol, with a long slender tube; both borders three-parted. FRUCTIFICATION—Capsule, three-celled; many-seeded.

GENUS, Curcuma, *Linn. Schreb.* FLOWER—Anthers, double; base bicalcarate. PERIANTH—Corol, both borders three-parted. FRUCTIFICATION—Capsule, three-celled. Seeds, numerous; arilled. Embryo, simple, with perisperm and vitellus.

GENUS, Amomum, *Schreb.* FLOWER—Anthers, double; surmounted with an entire, or lobate crest. PERIANTH—Corol, interior border unilabiate. FRUCTIFICATION—Capsule, three-celled; three-valved, Seeds, many; arilled. Embryo, simple, with perisperm and vitellus.

GENUS, Zingiber. FLOWER—Anthers, double; crowned with a single horn-shaped beak. PERIANTH—Corol, interior border unilabiate. FRUCTIFICATION—Capsule, three-celled; three-valved. Seeds, many; arilled. Embryo, simple, with perisperm and vitellus.

GENUS, Alpinia, *Schreb.* FLOWER—Anthers, double; naked. PERIANTH—Corol, interior border unilabiate. FRUCTIFICATION—Capsule, three-celled; berried. Seeds, few, or many; arilled. Embryo, simple, with perisperm and vitellus.

GENUS, Globba, *Schreb.* FLOWER—Filament, very long; base tubular and winged with a cuneiform lip. Anthers, double, with an appendix, or naked. PERIANTH—Corol, with the interior border two-lobed or none. FRUCTIFICATION—Capsule, one-celled; three-valved. Seeds, many; attached to three parietal receptacles. Embryo, simple, with perisperm and vitellus.

GENUS, Salicornia, *Schreb.* PERIANTH—Calyx, Gibbous, like an aril, lining the inside of the cavities of the fructification in the joints. Corol, none. FRUCTIFICATION—Seed, one.

DIANDRIA MONOGYNIA.

GENUS, Nyctanthes, *Schreb.* PERIANTH—Calyx, campanulate. Corol, salver-shaped. FRUCTIFICATION—Capsule, superior, obcordate, compressed, two-celled, two-valved. Berries, one or two. Embryo, erect, without perisperm.

GENUS, Jasminum, *Schreb.* FLOWER—Germ, two-celled, one seeded. PERIANTH—Corol, salver-shaped. FRUCTIFICATION—Seeds, solitary. Berries, one or two; superior. Embryo, erect, without perisperm.

GENUS, Phillyrea, *Schreb.* FLOWER—Germ, two-celled, two-seeded. PERIANTH—Calyx, four-toothed. Corol, one-petalled, four-cleft. FRUCTIFICATION—Berries, —— or drupe; superior; one or two-seeded. Embryo, inverse, and with a perisperm.

GENUS, Millingtonia, *Roxb.* FLOWER—Germ, two-celled, two-seeded. PERIANTH—Calyx, three-leaved, calycled. Corol, three-petalled; nectarial scale on the inside of each. FRUCTIFICATION—Seeds, solitary. Drupe, with one or two-celled, two-valved nut. Embryo, curved and folded, with little or no perisperm; a curved, inferior radicle.

GENUS, Olea, *Schreb.* FLOWER—Germ, two-celled, two-seeded. PERIANTH—Calyx, four-cleft. Corol, four-cleft. FRUCTIFICATION—Drupe, superior; one-seeded. Embryo, inverse, and with a perisperm.

GENUS, Chionanthus, *Schreb.* FLOWER—Germ, two-celled, two-seeded. PERIANTH—Calyx, four-parted. Corol, one-petalled; *segments* long. FRUCTIFICATION—Drupe, superior; one or two-seeded. Embryo, inverse, without perisperm.

GENUS, Schrebera, *Roxb.* PERIANTH—Calyx, bilabiate. Corol, salver-shaped. FRUCTIFICATION—Capsule, superior; turbinate; two-celled, two-valved. Seeds, several; membrane-winged.

GENUS, Eranthemum. *Lin. Flor. Zeyl.* FLOWER—Filament, four, two of them sterile. PERIANTH—Calyx, five-cleft. Corol, hypocrateriform; *border* cellular, or nearly so. FRUCTIFICATION—Capsule, two-celled, two-valved; bursting with elasticity opposite to the partition.

GENUS, Justicia, *Schreb.* PERIANTH—Corol, one-petalled; irregular. FRUCTIFICATION—Capsule, superior; two-celled, two-valved; bursting with elasticity contrary to the partition.

GENUS, Gratiola, *Schreb.* FLOWER—Filament, two, sterile, affixed to the lower lip of the corol. Anthers, double, and connected. PERIANTH—Corol, one-petalled; irregular. FRUCTIFICATION—Capsule, superior; two-celled, two-valved. Seeds, numerous.

GENUS, Utricularia, *Schreb.* PERIANTH—Calyx, two-leaved. Corol, rin-

gent, and generally calcarate. FRUCTIFICATION—CAPSULE, superior; one-celled. SEEDS, numerous.

GENUS, Lycopus, *Schreb.* FLOWER—STAMINA, distinct. PERIANTH—COROL, four-cleft, with one of the divisions emarginate. FRUCTIFICATION—SEEDS, four; retuse.

GENUS, Salvia, *Schreb.* FLOWER—FILAMENT, two-forked. ANTHERS, on the superior filaments. PERIANTH—COROL, irregular. FRUCTIFICATION—SEEDS, naked.

GENUS, Boerhavia, *Schreb.* FLOWER—GERM, one-celled. PERIANTH—CALYX, inferior; gibbous, entire, permanent, and becoming an envelope for the seed. COROLLA, campanulate; inserted on the calyx. FRUCTIFICATION—SEEDS, solitary. OVULA, single; erect. EMBRYO, conduplicate; with inferior radicle and central perisperm.

GENUS, Fraxinus*. PERIANTH—CALYX, none; or four-parted. COROLLA, none; or four-petalled. FRUCTIFICATION—SAMARA, one-seeded, with lanceolate wings.

GENUS, Ligustrum. PERIANTH—COROLLA, four-cleft. FRUCTIFICATION—BERRIES, superior; of two cells, with two seeds in each cell.

DIANDRIA TRIGYNIA.

GENUS, Piper, *Schreb.* FLOWER—GERM, one-celled; with a single erect ovulum. PERIANTH—COROLLA, none. INFLORESCENCE—AMENT, filiform; imbricated, with peltate scales. FRUCTIFICATION—BERRY, one-seeded. EMBRYO, inverse, and furnished with an ample perisperm.

TRIANDRIA MONOGYNIA.

GENUS, Valeriana, *Schreb.* PERIANTH—CALYX, none. COROLLA, superior; one petalled, gibbous on one side of the base. FRUCTIFICATION—SEEDS, one.

GENUS, Olax, *Schreb.* FLOWER—GERM, one-celled. PERIANTH—CALYX, Entire. COROLLA, three-petalled. NECTARY, of a few abortive filaments inserted on the petals. FRUCTIFICATION—DRUPE, half hid in the enlarged calyx; one-seeded. OVULUM, one, erect. EMBRYO, inverse and amply furnished with a perisperm.

GENUS, Lœflingia, *Schreb.* PERIANTH—CALYX, five-leaved. COROLLA, five-petalled. FRUCTIFICATION—CAPSULES, superior; one-celled, three-valved.

* Polygamous.

GENUS, Hippocratea, *Schreb.* FLOWER—GERM, three-celled. PERIANTH—CALYX, five-parted. COROLLA, five-petalled. FRUCTIFICATION—CAPSULES, three; one-celled, three-valved. SEEDS, membrane-winged. OVULÆ, a few; attached to the axis. EMBRYO, erect, without perisperm.

GENUS, Johnia, *Roxb.* FLOWER—GERM, three-celled. PERIANTH—CALYX, inferior; five-leaved or five-parted. COROLLA, five-petalled. NECTARY, or receptacle of the stamina and pistil sub-globular. FRUCTIFICATION—OVULÆ, one or two in each cell; peltate. EMBRYO, without perisperm; direction various.

GENUS, Iris, *Schreb.* FLOWER—STIGMA, *petals* four, corolled to bilabiate. PERIANTH—COROLLA, six-petalled. PETALS, unequal, alternate, jointed, and spreading.

GENUS, Morea, *Schreb.* FLOWER—STIGMA, three-cleft. PERIANTH, COROLLA, six-petalled; the three inner spreading, and narrower.

GENUS, Commelina, *Schreb.* PERIANTH—CALYX, inferior; three-leaved. COROLLA, three-petalled; often dissimilar. NECTARY, or sterile; filaments three; with a cuneiform head. FRUCTIFICATION—CAPSULES, two or three-celled. SEEDS, one, or more. EMBRYO, simple, and furnished with a perisperm.

GENUS, Sonerila, *Roxb.* FLOWER—GERM, three-celled; cells many-seeded; attachment central. PERIANTH—CALYX, superior; three-toothed. PETALS, three; on the mouth of the calyx, alternate with the stamina. FRUCTIFICATION—CAPSULES, three-celled. SEEDS, numerous, and minute.

GENUS, Xyris, *Schreb.* PERIANTH—CALYX, or *perianth* beneath; three-leaved. COROLLA, three-petalled, equal waved. NECTARY, three; bifid. INFLORESCENCE—HEAD, with roundish one-flowered scales. FRUCTIFICATION—CAPSULES, one-celled; three-valved. SEEDS, numerous; on parietal receptacles.

GENUS, Fuirena, *Schreb.* PERIANTH—COROLLA, three-petalled. INFLORESCENCE—AMENT, imbricated on the sides, with tailed scales. FRUCTIFICATION—CAPSULE, one; naked.

GENUS, Kyllingia, *Schreb.* PERIANTH—CALYX, of two chaffy valves. COROLLA, of two chaffy valves. INFLORESCENCE—AMENT, imbricated. FRUCTIFICATION—CAPSULE, one.

GENUS, Tringa, *Roxb.* PERIANTH—CALYX, one-valved; one-flowered. Co-

rolla, two-valved. INFLORESCENCE—Ament, ovate; imbricated on all sides. FRUCTIFICATION—Seed, naked.

GENUS, Schœnus, *Schreb.* PERIANTH—Calyx, or corol. FULCRA AND ENVELOPES—Glumes, several. FRUCTIFICATION—Seed, one naked.

GENUS, Cyperus. PERIANTH—Corolla, none. FULCRA AND ENVELOPES—Glumes, chaffy; bifariously imbricated. FRUCTIFICATION—Seed, one, naked.

GENUS, Scirpus. PERIANTH—Corolla, none. FULCRA AND ENVELOPES—Glumes, chaffy; imbricated on all sides. FRUCTIFICATION—Seed, one.

(*To be continued.*)

Art. VII.—Indication of a new genus of the Carnivora, with description of the species on which it is founded. By B. H. Hodgson, Esq. *Resident in Nèpál.*

Asiatic Researches, or Transactions of the Society, for enquiring into the History, the Antiquities, the Arts, and Sciences, and Literature of Asia, vol. xix. *pp.* 213. Calcutta, 1836.

There are some important communications in this volume, especially on the fossils found among the Sivalik hills, by Dr. Falconer and Capt. Cautley, and to which we alluded in a former number. We have only space this month to advert to one paper from Mr. Hodgson of Nepal, viz. indication of a new genus of the carnivora, with description of the species on which it is founded.

FAMILY CARNIVORA. TRIBE PLANTIGRADES.

GENUS URSITAXUS. MIHI.

Cheek Teeth $\frac{4.\ 4.}{4.\ 4.}$ *of ursine flatness almost, but musteline disposition;* the tubercular of the upper jaw, smooth-crowned, narrow, parallelogrammic, and smaller than the Carnivorous: none in the lower jaw: two false molars above and three below on either side: general conformation of the animal similar to that of the Badger, but wanting external ears: anal glands as in Mydaus.*

Remark.—*The natural affinities of this Genus are with Ursus, Taxus, and Mydaus; but chiefly with Taxus.*

The single animal from which the above characters are drawn was procured by me in 1829, since which period I have in vain endeavoured to obtain another: and, as I see no immediate prospect of better success in my search, I shall not longer defer giving such account of it as my materials enable me to supply.* The specimen I obtained was a mature male. It was recently killed, but had had the intestines removed before it was brought to me from the vale of *Muckwanpúr*, at the southern base of the last mountainous range towards India, whence I infer that its habitat is the hilly portion of the southern region of *Nepál.*

Species—Ursitaxus Inauritus. Earless Ursitax, *Mihi.*

See plate VI, figs. 2,3,4,5,6,7.

This is a low-legged unwieldy massive animal, with the general conformation and size of the Badger, from which, however, it differs most materially in its system of dentition, and more obviously in the want of external ears, the harshness and scantiness of its single coat of hair, and the disposition and number of its palmary tubercles.

The Earless Ursitax or Bear-Badger is thirty-two inches from the snout to the root of the tail, which is five inches long, or six and a half if measured with the terminal hair. The girth of its body, behind the shoulder, is twenty-nine inches, and the massiveness thence inferrible is maintained uniformly throughout its proportions. It is purely plantigrade and fossorial, dwelling in burrows on the southern slopes of the hills, and very seldom appearing abroad by day. The face, though not elongated, is conic and suddenly sharpened towards a neat, round, immobile, clearly defined, and ungrooved muzzle in which the nostrils are opened to the front, but have a narrow prolongation to the sides. The lips are closely applied to the jaws and entirely void of mustachios: nor are there any bristles on the cheeks, above the eyes, or on the chin; the cheeks are full and fleshy; the head broad, and as much depressed almost as the

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* That is, a disposition partially transverse, exhibited in the inner heel of the carnivorous tooth, and the whole body of the tuberculous one of the upper jaw. This arrangement of the teeth appears to be appendant to the true cutting type, and is not therefore developed in Ursus, or in other true plantigrades. Amongst the digitigrades it is common, and particularly so in the mustelidæ.

* This animal is mentioned by the local name of *Bharsiah*, in the catalogue of Nipalese Mammals, (832); and its peculiar dentition is therein summarily described.

Plate VI.

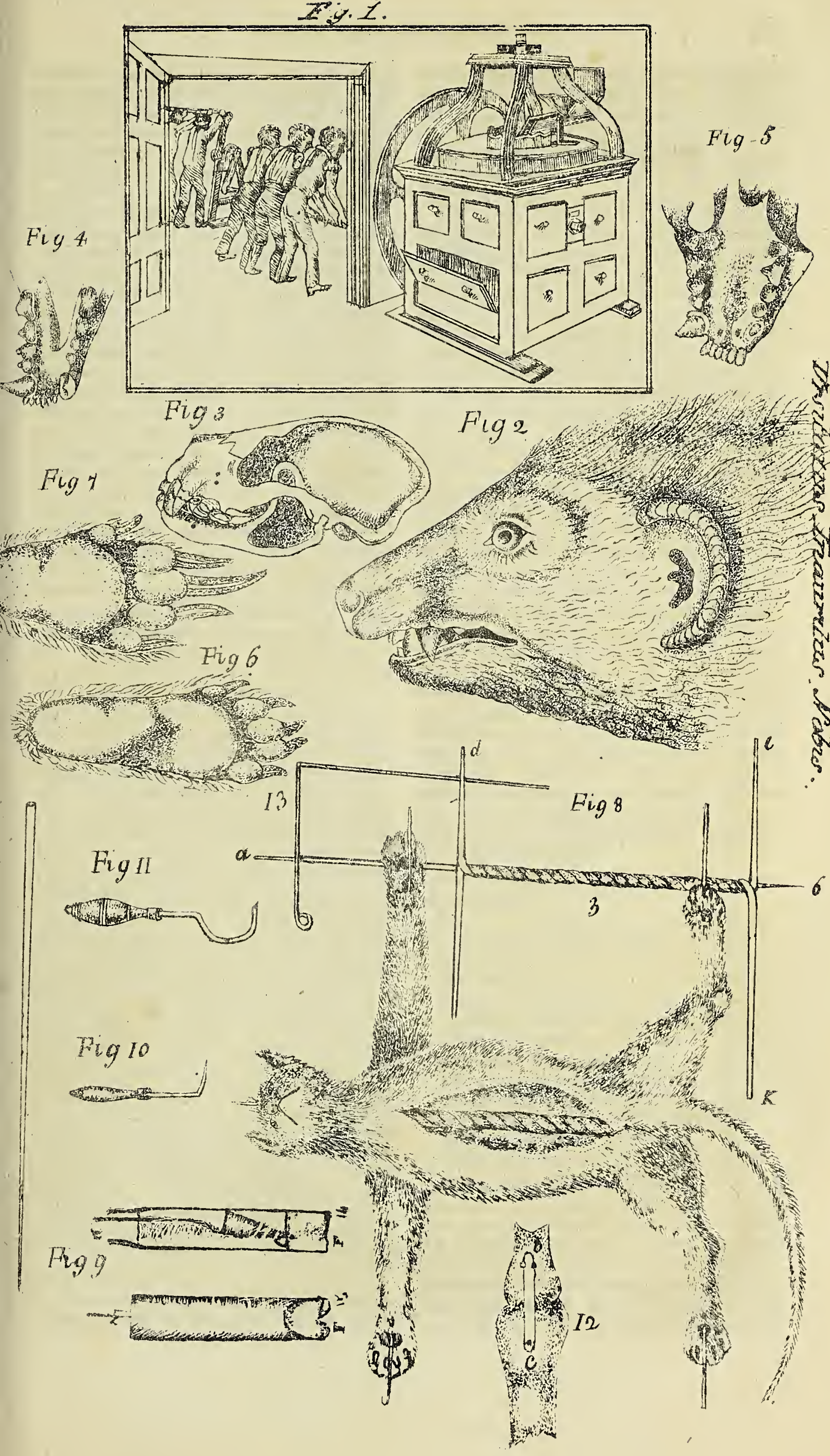

Fig. 1.
Fig 2
Fig 3
Fig 4
Fig 5
Fig 6
Fig 7
Fig 8
Fig 9
Fig 10
Fig 11
12
13

Otter's: the eyes small, round, level with the cheeks, possessed of a third lid which may be drawn two-thirds over the cornea, and of a round pupil; their position nearly equi-distant from the snout and ear. The nude ears are shaped and disposed pretty much as in the human subject: but the helix is wholly wanting, being replaced by a marginal obtuse swelling of the skin merely. The parallel portion of the anti-helix is rather more sharply defined; but the transverse is wholly absent: the tragus distinct, but the anti-tragus and lobe evanescent. The conch is elongated vertically like the rest of the organ, with but a small cavity and no superior definite limitation: the opening into the interior simple, apert, and round: the neck of the animal short and very thick: the body still thicker; being as deep almost as the length of the limbs, which are short and powerful, particularly the anterior ones. The digits are 5 in all four extremities, blended with the metacarpal and metatarsal joints so as to constitute solid pads for the feet, the anteal half only of the last phalanges being free, and connected superiorly by a small strong membrane which is firmly attached to the nails. The inferior surface of the hands and feet, to the back of the wrist and to the os calcis, is perfectly nude, the palms and soles being full, soft, and fleshy. At the forward end of each anterior digit is a very large ball, suitable to keep the huge nails from embarrassing the animal's walk; but the *bases* of all the 5 digits rest on one, undivided, round, pad, behind which is another, as large almost, and of similar shape, for the metacarpi. The balls of the hinder extremities resemble those of the fore, save that the metatarsal pad lies less centrally behind the termino-digital one, and is somewhat less developed. The gradation of the anterior digits is thus: the central largest, then the index, next the annular, then the external finger, retracted as in our hand, and with its nail similarly diminished; last the internal one, subremote as with us, but much the feeblest of all. The hind feet are considerably smaller than the fore: they have the external digits less retracted; the talons of the whole much less developed; more nearly equal in size; and gradated upon a different principle—the outermost being the stoutest, and the rest gradually but trivially diminished in strength towards the inmost. The nails of the anterior extremities are typically fossorial, sub-arched, shallow, stout, obtuse, obliquely compressed with broad convex backs, and a sharpened edge below.

The feet and hands of Ursitaxus are precisely similar to the same organs in the Bears, except that the digit answering to the thumb is rather remote in our animal—not so in Ursus—and that the interval between the terminal balls of the digits and their confusion with the palmary mass is nude in Ursitaxus—clad with soft hair in the Bears.

The anal glands of the Ursitax differ considerably from those of the Badger, agreeing point by point with the same organ in Mydaus (Horsfield), save only that the excretory ducts are rather longer in our animal and have their termination in the rectum rather nearer to its orifice and to one another. The tongue of the Ursitax resembles that of the Badger, being wholly covered with small papillæ, neither horny nor aculeated backwards. The covering of our animal consists of harsh hair only, and that very scantily furnished. It is about two inches in utmost length, straight and adpressed, sufficient in quantity to hide the skin upon the superior aspect only of the head, neck, and body; the face, neck, and body below, with the limbs internally, being partially nude. The colours are dirty yellow and black, clearly defined by a line passing from the brows along the flanks to the edges of the tail, and leaving all above it of the former—below it, of the latter, hue. The dirty tinge of the yellow upon the superior parts is caused by an admixture of yellow and black hairs, of which the former are more abundant and longer too than the latter, but both of similar harsh character. The tail, 5 inches long and scarcely reaching to the middle of the buttocks, is cylindrico-tapered and covered with hair like the back, the point being fine and a little recurved.

The following are the detailed dimensions of our animal—

	Ft.	In.
Tip of snout to base of tail,....	2	8
Tail only,..	0	5
Tail and hair,................	0	6½
Carpus (inclusively) to longest finger,....................	0	4⅛
Heel to longest toe,....	0	4½
Length of the head,..	0	6⅜
Nose to fore-corner of eye,.....	0	2
Thence to opening of ear,......	0	3¼
Girth of body, behind shoulder,..	2	5
Longest fore-nail,..	0	1½
Ditto hind ditto,....	0	0⅝

The skull is 5¾ inches long, 3⅛ wide, and 2¾ high. The width is taken, not between the zygomatic arches but between the alæ of the transverse crista. There the lateral dimensions are largest owing to the great development of the transverse or lambdoidal ridge of the skull before it sweeps upwards to join the zygomatic arches.

The scull bears, upon the whole, so great a similitude to that of the Otter, that it may be very well illustrated by pointing out the differences merely between the two. These consist in the slight arcuation of the outline along the parietal portion of the skull in Ursitaxus; the greater development of the frontal, nasal, and malar, bones; the diminished length of the zygomatic arches; the rather more incomplete and less advanced orbits; the very small size of the infra-orbitar foramina—which are besides two on either side—and, lastly, the larger development ($\frac{1}{3}$ more) of the tympanal bones. In respect to the teeth of the two animals there is no very noticeable difference in the incisors and canines which indeed are apt to assimilate in most of the carnivora.* The canines, however, are thicker, shorter, and blunter in our animal than in the Otter. The molars, too, of both are formed upon the same ultimately sectorial model and have a similar arrangement in the skulls: but they are fewer in number in Ursitaxus; and the trenchant processes of the crowns are almost obliterated. And, as if to defy all exclusiveness of system on our part, the Otter, with its sharp processes, has a very large flattish heel to the upper carnivorous tooth, and an extremely broad transverse tubercular behind it. On the other hand, the heel of the same tooth in Ursitaxus, though flatter, is smaller; and the tuberculous tooth behind it exhibits a much less, but a smoother surface. I regret that I have no Badger's skull wherewith to compare that of the Ursitax. Independently, as far as may be, of all comparisons, the skull and teeth of our animal have the following characters.

The Skull.—It is very thick and solid, with numerous rugosities all over its surface; is rather depressed than compressed, and very slightly but uniformly arched along the vertical line: parietes amply developed, affording a large cerebral cavity and shallow temporal fossæ: the cristæ of medial height, but running unbrokenly from the bifurcation of the brows to the zygomatic arches; their chief development being at the point where they sweep round to join those arches: frontal bones of considerable length and width: nasal, short but wide: both slightly convexed across; and, lengthwise, the former convex, the latter, sub-concave: malar bones uncompressed, with two small infra-orbitar foramina on either side: zygomatic arches, short, stout, considerably bulged outwards: orbits medial, very incomplete, there being no process from the zygoma, and but a small one from the os frontis: frontal sinuses medial or largish: occipital bones dipt vertically from the junction of the lambdoidal and sagittal sutures, so that the condyles of the foramen magnum are neither posteal nor anteal to that junction. There is a short but strong vertical crista on the occiput, and a transverse one of much greater extent, parallel and closely approximated to the lambdoidal ridge. The bony separation of the cerebrum and cerebellum is very strong aud much developed, leaving a long, elliptic, vertical foramen in the midst, nearly twice the size of the great foramen: the tympanal bones amply developed, semi-ovoid, and reaching forwards to the articulation of the jaws, which is so complete, in the cylindrical hinge manner, that the lower jaw can be barely removed from the skull. The rami of the lower jaw are nearly straight, very powerful, short, uncompressed, or remote, and furnished with large subvertical coronoid processes, and small styloid ones: the condyles nearly on a line with the upper cheek teeth.

The Teeth.—The incisors are all disposed rectilinearly to the front, erect, strong, cylindrical in their bodies, and broad-crowned; the crowns of the lower ones being horizontal—of the upper, obliquely sloped inwards. The external incisors are the stoutest, and the rest gradually decrease in thickness to the central pairs. These teeth are all in contact with each other; and, in lower range, with the canines also: but the front teeth of the upper jaw have a necessary interval from the canines for their passage. The canines are short, stout, obtuse, conic, and of equal size above and below. They are mutually scarped by friction against each other, but exhibit no heel. The upper canines are straight; the lower, subcurved. All the molars are in contact with each other, but not quite with the canines. They are sixteen in all—four on each side of either jaw, of which the two first of the upper, and three first of the lower range are false molars; the 3d above, and the 4th below, the carnivorous tooth; and the 4th above the tuberculous one. Below there is no such tooth. All are disposed lengthwise, save the tuberculars of the upper jaw which have a transverse arrangement, causing a triangular vacancy between them and the internal heels of the carnivorous teeth of the same jaw. The molars gradually increase in size as they recede from the canines in the lower jaw;

* In the form of the incisor teeth Ursitaxus differs entirely from Mydaus, with which animal it has several points of affinity. Other differences occur in the structure of the ears and of the extremities—not to mention the cardinal distinction between the molar teeth of the two.

but, in the upper, the carnivorous tooth is considerably larger than the tubercular; which latter is of the form of an oblong, narrow, parallelogram, with a perfectly smooth concave crown. All the molars are fanged and essentially constructed as in the digitigrade or normal carnivora; but, owing to the nearly obsolete development of the cutting processes of their crowns they bear a character of greater resemblance to the molars of the typical plantigrades.

The scissor action or true cutting process must in respect to these teeth be limited to the carnivorous ones, and even there be more than matched by the crushing action of one crown on another. The whole of the molars are longer considerably than broad: but they are almost as evidently broader than high. Heretofore it has been remarked that in proportion to the diminished number of the molars is the high development of their sectorial attributes: but in Ursitaxus we have molars less only in number than those of the cats proper, which yet are distinguished for the remarkable flatness of their crowns.*

Deeply imbedded in the cellular membrane at the outlet of the pelvis and centrally on either side the large anus, the Ursitaxus has an oblong, spheroidal, hollow gland, which communicates, by a distinct tubular canal, with a round pore opening on the caudal margin of the anus. Each gland is 1¼ inch long and ¾ wide, being large enough to contain a walnut; and each has its own canal and its own pore. These pores or anal orifices of the glands are about ¾ of an inch apart. The ducts uniting them with the glands take a superior direction to open at the upper margin of the anus, under the tail; and they exhibit at either end a muscular ring. The walls of the glands are about ¼ inch thick, and purely glandular; and their lining membrane lies closely in contact with the walls and is secretory throughout. But no pores can be traced on this lining for exuding the secretion which yet is contained in the cavity of the glands whence it passes by the tubes and anal pores into the rectum. The secretion found in the dead subject was dark, thick, and very fœtid.

* I make due allowance for detrition by use owing to the age of my specimen: but there still remains a remarkable flatness of crown in the molars, greatly exceeding that of the semifrugivorous Paradoxuri for example. Such teeth, being only sixteen in total number, of which but two are tuberculous, constitute surely a singular and unique type amongst the Carnivora.

GENERAL SCIENCE.

CATALOGUE OF PLANTS COLLECTED AT BOMBAY.

By John Graham, Esq.

(*Continued from page* 449.)

172. Datura *fastuosa*. Common.

173. Dracæna *ferrea*. In flower pots only.

174. Dimocarpus *litchi*. In gardens, though not common. It bears fruit here but not equal to that obtained from China.*

175. Dalbergia *arborea*, native name Carunj. A very pretty tree; leaves deciduous in the cold weather.

176. ,, *Sissoo*. Black wood used extensively in making furniture.

177. ,, *scandens*.

178. Dolichos *tuberosus*.

179. ,, *cultratus*. A species of Dolichos is much cultivated and eaten like French beans, the *tetragonolobus*.

180. ,, *pruriens*.

181. Dioscorea *sativa*. Common yam.

182. ,, *bulbifera*.

183. Diospyros *Ebenum*.

184. Daemia *reticulata*.

185. Dillenia *speciosa*.

186. Diospyros *montana*.

187. ,, *hirsuta*.

188. Daphne *Bholua*.

189. Dendrobium,? On the Ghauts.

190. Dombeya *palmata*. In gardens only.

191. Exacum *bicolor*.

192. Evolvulus *hirsutus*.*

193. Euphorbia *Tirucalli*. Common milk bush.

194. ,, *antiquorum*.

195. ,, *tithymaloides*. Used for edgings instead of box.

196. ,, *neriifolia*.

197. ,, *hirta*. A common weed.

198. Eugenia *jambos*. Jambler, rose apple.

* The *Litchi* forms the favourite fruit in Chinese deserts. It resembles somewhat the fruit of the Maple (*Acer Campestre*) in external appearance. The tree grows in a wild state in French and Danes' Islands, Whampoa.—Edit.

* Is this not a variety of E. *alsinoides*, a common plant in China?—Edit.

199. ,, *Malacciensis.*
200. Erythrina *Indica.* A deciduous tree. It flowers in March and makes a very showy appearance.
201. Eupatorium *Zelonia.*
202. Eclypta *prostrata.*
203. Elephantopus *scaber.*
204. Feronia *elephantum.* Wood apple, a large handsome tree.
205. Ficus *Carica.* In gardens only.
206. ,, *religiosa.* Pepul tree.
207. ,, *Indica.* Banyan tree.
208. ,, *elastica.*
209. ,, *racemosa.*
210. ,, *pubescens.*
211. Flacourtia *sapida.* In gardens only.
212. ,, *sepiaria.* Elephanta.
213. ,, *inermis.*
214. Guazuma *ulmifolia.*
215. Gardenia *radicans.* In gardens only, cultivated for its beautiful, white, sweet smelling flowers.
216. Gardenia *lucida.* Elephanta.
217. ,, *dumetorum.*
218. ,, *esculenta.*
219. Getonia *floribunda.*
220. Grewia *orientalis.*
221. Gomphrena *globosa.* In gardens only, cultivated for its flowers.*
222. Gloriosa *superba.* Common during the rains.
223. Guilandina *bonduccella.*
224. Gärtnera *racemosa.*
225. Garcinia *Cowa.* Common in the Concan.
226. Grewia *Asiatica.*
227. Gerardia *delphinifolia.*
228. Gmelina *arborea.*
229. ,, *Asiatica*
230. Gossypium *herbaceum.*
231. Glycine *Sinensis,*
232. Galega *purpurea.*
233. Garuga *pinnata.*
234. Grislea *tomentosa.*
235. Hoya *carnosa.* Cultivated as an ornamental plant.
236. ,, *viridiflora.*
237. Hyperanthera *Moringa.* Very common.
238. Helicteres *ixora.*
239. Hibiscus *populneus.* Bhendy tree.
240. ,, *rosa Chinensis.* Cultivated as an ornamental plant.
241. ,, *mutabilis.* Ditto ditto.
242. ,, *Sabdariffa.* Iropille, used in making jellies, tarts, &c.
243. ,, *esculentus.* Commonly cultivated.
244. ,, *surratensis.*
245. ,, *cannabinus.*
246. ,, *tricuspis.*
247. Hedysarum *gyrans.*
248. ,, *strobiliferum.*
249. ,, *tuberosum.*
250. ,, *vespertilionis.*
251. Hemidesmus *Indicus.*
252. Ixora *coccinea.*
253. ,, *parviflora.*

* Indigenous to China.—Edit.

254. Ipomœa *Quamloquit.* Cupid's flower.*
255. ,, *fragrantissima*
256. ,, *tuberosa.*
257. Impatiens *Balsamina.*†
258. Inula *Indica.*
259. Jasminum *Sambac.* Mogrel, native name, extensively cultivated for its flowers.
260. ,, *odoratissimum.*
261. ,, *latifolium.*
262. ,, *undulatum.*
263. ,, *auriculatum.*
264. Justicia *picta.* Common in flower pots.
265. Justicia *nervosa.*
266. ,, *bivalvis.*
267. ,, *montana.*
268. Jonesia *pinnata.* On Salsette.
269. Jatropha *curcas.* Used for forming hedges.
270. ,, *manihot.* In gardens only, very rare.
271. ,, *multifida.* In gardens, as an ornamental plant.
272. Kydia *fraterna.*
273. Kyllingia *umbellata.* Grass.
274. Loranthus. Several species.
275. Lawsonia *inermis.* Used for forming hedges.
276. Laurus *cinnamomum.* In gardens only.
277. ,, *Persea.* In gardens only.
278. Limonia *monophyllum.*
279. ,, *trifoliata.*
280. Lagerstroemia *regina.* In the Concan.
281. ,, *Indica.*
282. ,, *parviflora.*
283. Lantana *purpurea.*
284. Lepidagathus *cristata.*
285. Menyanthes *cristata.*
286. ,, *Indica.*
287. Mussaenda *frondosa.* On the Ghauts.‡
288. Morinda *Indica.*
289. ,, *citrifolia.*§
290. Mirabilis *Jalapa.* In gardens.
291. Mangifera *Indica.*
292. Mimusops *elengi.*
293. ,, *hexandra.*
{ Both pretty trees commonly planted by Musselmen around towns, such as Aurungabad &c.
294. Murraya *exotica.* In gardens only.
295. Melia *azidiraltea.* Neem tree.
296. Myrtus *communis.* In gardens.
297. Maumea *America.* In gardens, rare.
298. Michilea *champaca.*
299. Momordica *charambee.* Commonly cultivated as an article of food.
300. Menispermum *cordifolium.*
301. Musa *paradisaica.* Plaintain.
302. Musa, ? On Ghauts.
303. Mimosa *pudica.*
304. ,, *cinerea.*
305. ,, *Arabica.* Babool tree; common; in extensive use as firewood.

* This plant is indigenous to Danes' Island, China.—Edit.
† This species occurs in China.—Edit.
‡ Abundant on French Island, Whampoa, China.—Edit.
§ A native of China.—Edit.

306. ,, *scandens.* On the Ghauts.
307. ,, *Sirissa.*
308. ,, *glauca.*
309. ,, *dulcis.*

(*To be continued.*)

ON SOME METHODS OF ASTRONOMICAL OBSERVATION.

By William Galbraith, A. M.,
Teacher of Mathematics, Edinburgh.

(*Continued from page* 452.)

ON THE METHOD OF FINDING THE VALUE OF THE DIVISIONS ON THE SCALES OF LEVELS APPLIED TO ALTITUDE AND AZIMUTH CIRCLES, REGISTERING OBSERVATIONS, &c.

All the more usual astronomical instruments have a level applied to them so as to insure the verticality of their axis, or to make the necessary allowance for their deviation from it. The scale of the level is so graduated as to show single seconds, or some multiple of the second, and reads most conveniently from a central zero. In those instruments that revolve in azimuth, which all the smaller, and more especially the portable, circles do, (and even the large eight feet circle at Dublin, though provided with a plumb line rather inconveniently situated, and the most accurate, perhaps in principle, of any hitherto constructed,) the observations are repeated several times in pairs near the meridian, reading the divisions at both extremities of the air bubble on the scale of the level each time along with the verniers or microscopes. When there are three verniers and about six observations made, it is advantageous to have a simple and convenient method of registering the observations, taking the means, and allowing for the effects of the level.

The value of the divisions of the level is generally got from the maker, or it may be readily found by an instrument called the level trier, constructed expressly for this purpose.

If the observer has not had these communicated to him, or if he wishes to satisfy himself with regard to the accuracy of the values given to him along with the instrument, he may either ascertain these by the circle itself, when the verniers or reading microscopes are competent to the purpose, or he may have recourse to the following methods, which, in the course of my experience, I have found very convenient.

1. Put up the usual levelling rod of the best construction truly vertical, at such a distance from the circle as may be most convenient, though somewhat considerable.

2. Set the level exactly in the direction of two of the feet screws, or one perpendicular to the line joining the other two, when there are three; clamp the verniers, and direct the intersections of the cross wires of the telescope to the mark on the sliding vane, which must be moved up or down till an exact coincidence takes place.

3. By turning one of the feet screws cause the bubble to move through a given number of the divisions of the scale, comprehending those usually employed in recording observations, while at the same time the sliding vane must be moved till its mark again coincides with the intersection of the cross wires in the telescope, still clamped to the circle, and the number of divisions on the rod which it has passed over to thousandths, or, at least, hundredths of a foot, by this motion must then be recorded.

4. Measure the horizontal distance with great care between the centre of the circle and the levelling rod. These afford data for computing trigonometrically the value of the divisions of the scale of the level.

5 To investigate formulæ for this purpose let R'' be the length of an arc equal to the radius in seconds, D the horizontal distance, d the distance passed up or down by the vane A'' the arc in seconds subtended by d, at the distance D then by the principles of trigonometry,

$$A'' = \frac{R'' \times d}{D} \quad \ldots\ldots \quad \ldots\ldots \quad (1)$$

If L be the length of a given number of seconds, a'' on the scale of the level, and r the length of the whole run in the same measure as D and d,

$$L' = \frac{D \times a'' \times r}{R'' \times d} \quad \ldots\ldots\ldots\ldots\ldots \quad (2)$$

Indeed, if any four of the five quantities, D, d, r, a'', and L be known, the value of the fifth may be found by transforming the preceding equation, thus:

$$a'' = \frac{R'' \times L \quad d}{D \times r} \quad \ldots\ldots\ldots\ldots \quad (3)$$

If n be the number of divisions in the run of the level,

$$a' = \frac{R'' \times d}{D \times n} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

If ρ be the radius of curvature of the level,

$$\rho = \frac{R'' \times L}{a''} = \frac{R' \times r}{A''} \quad \ldots\ldots \quad (5)$$

Examples for the use of these formulæ.

1. The cross wires of the telescope of an astronomical instrument, at the distance of 250 feet from a levelling rod, moved over two inches in a run of the bubble through an inch and a half, by turning the feet screws in the direction of the level and rod, what was the value of the whole arc A' passed over by the bubble, and the length L, of a division of a'' (10'') on the scale of the level?

By formula (1) $A'' = \frac{R'' \times d}{D} = \frac{206264''\cdot8 \times 2}{3000} = 137''.51$

By formula (2) $L = \frac{D \times a'' \times r}{R \times d} = \frac{3000 \times 10 \times 1.5}{206264\cdot8 \times 2} = 0.109$ in.

From this last formula, a scale may be readily adapted to a level.

2. Let the length L of one of the divisions of the scale of a level be one-twentieth of an inch, the run of the bubble two inches, the distance d one inch, and a fifth, and D five hundred feet, required a'', the value of one division of the scale in seconds?

$$\text{By formula (3) } a'' = \frac{R'' \times L \times d}{D \times r} =$$

$$\frac{206264''\cdot8 \times 0\cdot05 \times 1\cdot2}{6000 \times 2} = 1''\cdot103$$

3. At the distance $D = 90\cdot6$ feet, the vane of a levelling rod passed over 0·06 of a foot in a run of 25 divisions of the level, what was the value a'' of one division of the scale, and the radius of curvature of the level, L being one-tenth of an inch?

$$\text{By formula (4) } a'' = \frac{R'' \times d}{D \times n} =$$

$$\frac{206264''\cdot8 \times 0\cdot06}{90\cdot6 \times 25} = 5''\cdot5$$

$$\text{By formula(5) } \rho = \frac{R' \times L}{a''} =$$

$$\frac{R'' \times \frac{1}{10} \times \frac{1}{12}}{5'.5} = \frac{R''}{5\cdot5 \times 10 \times 12} =$$

$$\frac{206264''\cdot8}{660} = 312\ 5 \text{ feet.}$$

This result 5''·5 is nearly the value of one division of a level attached to a six-inch travelling circle of Captain Kater's construction, made by Robinson. It is obvious, that the same method may be applied to determine the value of the divisions of a level belonging to larger instruments when required, and it is susceptible of very considerable accuracy when sufficient care is taken in performing the necessary operations.

II. After having determined the value of the divisions of the scale of a level, it is next proper to adopt a simple and ready method of applying its effects to observations.

Let e be the eye end of the telescope next the observer, o the object end, a'' the value of one division of the level in seconds, n the number of observations, and l their effect when applied to the zenith distance.

$$l = \frac{(e - o)\ a''}{2\,n} \ldots\ldots\ldots\ldots\ldots \quad (6)$$

The sign must be changed when applied to the altitude.

III. When three or more verniers are applied to a circle, and the observations are repeated and read each time, the mean result will be readily determined by the following formula in which $\sum r$ is the sum of the readings of all the verniers or microscopes, n the number of observations, v the number of verniers, and m the mean value of the whole.

$$m = \frac{\sum r}{n\,v} \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

These formulæ will apply with ease and certainty to any case likely to occur in practice, and are more simple than any I have seen.

IV. The case to which they are now to be applied is one of a series of observations made by a small circle of Captain Kater's construction, to determine the obliquity of the ecliptic at the late summer solstice, at Edinburgh, in latitude 55° 57' 15'' 67 N.

It may seem to be an attempt much beyond the powers of so small an instrument, one of six inches diameter, furnished with three verniers, each showing 15 and a level, indicating by each division only to the accuracy of 5''·5. Yet, the correctness of the final result, which differs from Bessel's by about 1'' ⅓, and from mine, obtained by a comparison of the late observations made at Greenwich, with those of Bradley, reduced with the best tables by 1'' ⅓, shows how much may be accomplished with moderate means. With what pleasure would modern astronomers have contemplated the observations of Hipparchus and Ptolemy had they been made with such precision!

To determine the obliquity of the ecliptic in the most accurate manner, the sun's declination (daily if possible), near the solstices, must, it is well known, be observed carefully for some time, and the results, by means of appropriate formulæ or tables, are reduced correctly to the moment of the solstice computed from the best solar tables, or obtained from corresponding observations.

(To be continued.)

EXPERIMENTS ON THE ABSORPTION OF AIR BY WATER.

By Thomas Thomson, M. D., F. R. S. L. and E., &c.,
Regius Professor of Chemistry in the University of Glasgow.

Not being aware of any direct experiments upon the subjects mentioned in the title of this paper, I amused myself, during the early part of the present summer, in making a few trials to satisfy myself whether the opinions at present entertained on these subjects were entitled to confidence. I shall state my experiments on each of the different subjects in order.

I.—OF THE QUANTITY OF AIR CONTAINED IN CLYDE WATER.

The city of Glasgow is supplied with water pumped out of the river Clyde, and conveyed to reservoirs in the higher parts of the town, from which it is conveyed in pipes to every house. As one of these pipes supplies my laboratory, I have only to turn a stock cock to obtain as much river water as I have occasion for.

1. I filled a retort, the belly of which held 168 cubic inches, and its throat and beak 75

cubic inches more, with river water, plunged the beak into a water trough, and placed a small inverted jar full of water over the extremity of the beak. I then boiled the water till it ceased to give out any air. I collected 5·25 cubic inches of air. Barometer at 29·5 inches. Thermometer 53°. f

In this experiment 168 cubic inches o water gave out 5·23 cubic inches (making the requisite corrections) of air, supposing the barometer at 30 inches and the thermometer at 60°. The 75 cubic inches which filled the throat and beak of the retort became hot, and no doubt gave out a little air; but not much; because, as soon as the water in the retort began to boil briskly, the water in the throat and beak was driven out by the steam, and never boiled at all. Thus, it appears that 100 cubic inches of Clyde water contain 3·113 cubic inches of air.

The experiment being repeated in precisely the same way, the product of air was so nearly the same that it seems unnecessary to state the particulars minutely.

II.—COMPOSITION OF THE AIR THUS EXTRACTED.

I let up 100 volumes of this air into a small jar, filled with water and standing over the water-trough, and put into it a stick of phosphorus of such a length that it reached from the bottom to the top of the jar, and traversed all the air. In 24 hours the bulk of this air was reduced to 71·48 volumes of azotic gas. Hence, the air extricated from the water was composed of

71·48 volumes of azotic, and
28·52 volumes of oxygen gas.

The air extricated during the second experiment, analyzed in the same way, was composed of

70·32 volumes of azotic, and
29·68 volumes of oxygen gas.

If we take the mean of these two analyses, we get the constituents of the air extracted from Clyde water by boiling as follows:

Volumes of azotic gas . . .	70·9
Volumes of oxygen gas . . .	29·1
	100·0

III.—ALTERATION PRODUCED ON THIS AIR WHEN LEFT STANDING ON THE WATER-TROUGH.

1. The 5·25 cubic inches of air extracted by boiling water from the Clyde, were put into a small cylindrical glass capable of holding 11 cubic inches, and left inverted over the water trough. Every 24 hours 1 cubic inch (or 100 volumes) of this air was taken out, and left till next day with a stick of phosphorus passing through it. The following table shows the composition of the air after standing over the water.

	Azotic.		Oxygen.
1. Fresh extracted of..	71·48	+	28.52
2. After one day ..	74·43	+	25·57
3. After two days ..	75·38	+	24·62
4. After three days ..	77·51	+	22·49
5. After four days ..	80·97	+	19·03

2. The 5·25 cubic inches extracted from he second quantity of water by boiling was treated in the same way: excepting that the 11 cubic inch jar containing the air, instead of standing open on the water-trough, was corked tight. The result was as follows:

	Azotic.		Oxygen.
1. Air newly extricated composed of	70·32	+	29·69
2. After one day .	72·5	+	27·5
3. After two days .	73·44	+	26·54
4. After three days .	73·35	+	27·65
5. After four days .	77·43	+	22·57

Here, as in the first case, the oxygen was absorbed more rapidly than the azotic gas; but the rapidity of this absorption was somewhat diminished by corking the glass in which the air was kept.

IV.—ALTERATION PRODUCED ON COMMON AIR BY LEAVING IT STANDING IN A GLASS VESSEL INVERTED ON THE WATER-TROUGH.

Curious to know whether a similar diminution in the quantity of oxygen in common air would take place when left standing over the water-trough, as had taken place in the preceding experiments with air extricated from water by boiling, I put ten cubic inches of common air, collected at the window of my laboratory on a windy day, into a cylindrical glass jar and left it standing inverted over the water-trough, analyzing every day one cubic inch by means of phosphorus, till the whole was exhausted. The following table shows the result of these analyses.

	Azotic.		Oxygen.
1. After standing 24 hours	79·47	+	20·53
2. After two days	79·27	+	20·73
3. After three days	lost		
4. After four days	79·65	+	20·35
5. After five days	79·65	+	20·35
6 After six days	82·99	+	17·01
7. After seven days	80·71	+	19·29
8. After eight days	80	+	20
9. After nine days	80·84	+	19·16
10. After ten days	82·26	+	17·74

On the ninth day, after analyzing the gas, I dissolved some sulphate of iron in the water-trough. This is the reason of the greater proportion of azotic gas found in the last cubic inch of the air, which was analyzed on the tenth day.

If we compare these experiments with the former ones, we must be struck with the great difference between them. The air extracted from water by boiling is much richer in oxygen than common air, containing rather more than 29 per cent., while common air contains only 20 per cent. by volume. But this excess of oxygen diminishes rapidly; so that after four days it does not contain more than common air does.

Common air, on the contrary, may be left upon the water-trough for ten days without undergoing any sensible alteration in its composition. Indeed I left nine cubic inches of air in a tube standing inverted over water, from the first of May to the 25th of that month, and found its constituents unaltered.

If we take the mean of the constituents of air from the preceding table, leaving out the

last term, because the sulphate of iron had increased the quantity of oxygen absorbed, we obtain

Azotic gas	80·32 volumes.
Oxygen gas	19·68 ,,
	100·00

Now this differs very little from the composition of air. If we analyze air without removing previously the carbonic acid gas and the moisture which it contains, we always find the volume of its oxygen below 20 per cent.

(To be continued.)

ON MANGANIC AND HYPERMANGANIC ACIDS, ON HYPERCHLORIC ACID, AND THE SALTS OF THESE ACIDS.

By E. Mitscherlich.*

Scheele first observed a part of the phenomena, which, as I shall immediately show, are produced by two acids formed from manganese; and after him chemists of eminence have repeatedly turned their attention to the subject. Chevreul, Chevillot, and Edwards, Forchhammer, Fromherz, and Unverdorben, have added more or less interesting facts to those previously known, although they have by no means exhausted the subject. These compounds, however, would unquestionably have been long ago completely investigated, had not the great difficulty of obtaining the pure acid in sufficient quantity rendered their examination almost an impossibility. They are decomposed very easily by a great number of circumstances; their solutions cannot be filtered, nor their crystals laid upon paper, because they are instantaneously decomposed by organic substances.

Very distinct crystals, which I obtained of manganate of potash, enabled me to determine their shape, and as it was found to agree in every respect with that of the chromate, seleniate, and sulphate of potash, this circumstance, which is particularly interesting in the elucidation of the connexion of the crystalline shape of bodies with their composition, induced me to investigate more closely these acids and their compounds.

I.—ON THE ACTION OF POTASH ON THE BINOXIDE OF MANGANESE.

When equal parts of potash and binoxide of manganese are ignited together, and the ignited mass treated with water, a green solution is obtained, which contains in solution, carbonate of potash, caustic potash, and a compound of potash with manganese in a higher degree of oxidation, while a brown powder remains undissolved. Oxygen is absorbed when the mass is ignited in contact with the air, as Edwards and Chevillot have already shewn. But the green compound may be obtained equally well, when the binoxide of manganese is ignited with potash in a retort shut up from the air. Thus 10 grammes of binoxide of manganese, heated with potash without the access of air, and treated with water, gave a solution, which, when the acid was decomposed, and the manganese precipitated and ignited, yielded 1 gramme of the red oxide (oxidum manganeso-manganesicum.)

In this case, the higher degree of oxidation of the manganese is produced in the same manner in which the brown oxide of lead is formed from red lead, when the latter is treated with nitric acid, and the brown residue which is left, when the green compound is dissolved, consists of hydrated sesqui and binoxides of manganese, but whether mixed or chemically combined, I cannot venture to decide. The manganic acid is formed by a part of the binoxide giving up a portion of its oxygen to the remainder, by which it is changed to sesquioxide, but the quantity of manganic acid formed, shows that a portion of the binoxide remains undecomposed.

If we pour off the deep green solution, after allowing the brown insoluble portion to subside, and allow it to evaporate over sulphuric acid, under the exhausted receiver of an air pump, we obtain beautiful pure crystals of a green colour, mixed with abundance of crystals of hydrate and carbonate of potash. These crystals must be laid on porous tile or clay, which absorbs the moisture without producing decomposition. If the solution be allowed to evaporate in contact with the atmosphere, red crystals, the composition of which I shall attend to afterwards, may be formed by the action of the carbonic acid of the air.

If the green crystals be treated with water, a red solution is obtained, which, by evaporation, yields red crystals. The green crystals consist of manganate of potash, which is isomorphous with sulphate of potash, while the red have the same form as the perchlorate of potash. Accurate analyses have shown that both the perchloric acid and the highest degree of oxidation of magnanese, contain 7 proportions of oxygen. It appears to me, therefore, to be convenient to denominate that degree of oxidation of manganese which corresponds with sulphuric, selenic, and chromic acids, *manganic acid*, while the highest degree of oxidation of manganese may be called *hypermanganic acid*, and that of chlorine *hyperchloric acid*, following the nomenclature of Gay Lussac with respect to *hypo*-sulphuric acid.*

(To be continued.)

* Poggendorff's Ann., xxv., 287. (The publication of this interesting paper is rendered necessary to illustrate that of Dr. Clark, printed in Records, vol. iii. 433, and vol. iv. 43. —Edit.)

† In this investigation I have been greatly aided in the preparation of the substances by my assistant, M. Wolff, a very skilful pharmaceutist.

ON ELECTRO-PULSATIONS AND ELECTRO-MOMENTUM.

By William Sturgeon,

*Lecturer on Experimental Philosophy at the Honourable East India Company's Military Academy, Addiscombe, &c.**

It is very well known to the readers of the Philosophical Magazine, that I have long considered electric currents, when transmitted through inferior conductors between the poles of a voltaic battery, as the effect of a series of distinct discharges, in such rapid succession as not to be individually distinguished by the senses. Such currents I have called electro-pulsatory. See my theory of magnetic electricity in the London and Edinburgh Philosophical Magazine, vol. ii. p. 202.

By following up these views of electro-pulsations, I was about two years ago enabled to dispense with all acid or saline liquids, in the employment of galvanic batteries, for the purpose of galvanizing, as it is called, either to satisfy the curiosity or as a medical process; and my plan, which answers very well, I have found to be productive of a considerable saving in the expense necessarily attendant on the use of voltaic batteries when excited by acid solutions.

It is well known that a Cruickshank battery of about a hundred pairs will, by employing water alone in the cells, charge to a certain degree of intensity almost any extent of coated surface of glass that we please; and that the same degree of charge is given to it by a single contact of the conductors, however short its duration. This being understood, and understanding also that the shock produced by any discharge from a given intensity would be proportional to the quantity of fluid transmitted in a given time, it was easy to foresee that a series of shocks in rapid succession might be produced by some mechanical contrivance, and that the degree of force might be regulated by varying the extent of coated surface.

My first experiments were made with a hundred and fifty pairs of three-inch plates, and about seven feet on each side of coated glass; and my apparatus for producing a rapid succession of shocks was one of Mr. Barlow's stellated electro-magnetic wheels† which was soldered to an iron spindle and put into rotatory motion by a wheel and band; the points of the wheel touching in succession a copper spring in connexion with the positive surface, and thus producing a discharge at every contact of the wheel and copper spring.

When the two surfaces are connected by wires with two basins of salt water, and the hands immersed one in each basin, the effect experienced is precisely that of the discharge of a voltaic battery. The discharges can be made in such rapid succession as to prevent the sensation of distinct shocks; and if the process were to be concealed it would require some experience to distinguish between the effects on the animal œconomy from this apparatus and those from a voltaic battery charged with acid and water.

My views being so far verified, the next attempt was to simplify the apparatus and make it more portable; and as it was readily seen that if one hundred pairs would charge glass of considerable thickness, thinner glass might be charged by fewer pairs; this was done; and eventually the glass entirely dismissed, and its place supplied with well-varnished Bristol-board. These boards answer exceedingly well as a reservoir for low intensities; they may be coated to within an inch of the edge all round, and placed upon their edges either on a piece of glass or on a board properly prepared, and arranged to any required extent like the plates of a voltaic battery, but when considerable intensity is wanted, it is better to use thin glass.

From these facts we learn that metallic surfaces of many acres of extent may possibly be charged to a low intensity in the interior of the earth, by having a thin intervening stratum of inferior conducting matter sufficient to insulate from each other their dissimilar electric surfaces.

It may now be understood that the slightest accident which would suddenly break through the insulation, such as the sinking of a mass of metalline matter from one stratum to the other, would cause a sudden rush of an immense ocean of the electric fluid, which might be productive of subterranean lightenings and tremendous explosions sufficient to shake an extensive range of country on every side.

Connected with the preceding facts there are others which may be conveniently mentioned in this place, and which would lead us to similar explanations of the causes of subterraneous convulsions. Electric currents of considerable magnitude when suddenly checked, or diverted to a new channel, produce a momentum not very genrally understood; but which I will endeavour to explain. A coil of copper wire excited

* Communicated by the Author.

† [See Phil. Mag., First Series p. xi. vol lix, 241.—Edit.]

by magnetic action will become a channel for an electric current; and whilst the whole circuit is metallic, the velocity of that current would be considerably greater than if any, even a small part of the circuit were of worse conducting materials: and if the current were suddenly transferred from a channel of the former character to one of the latter, by any contrivance whatever, it would meet a resistance on entering the new channel, which the momentum it had previously required would have to overcome; and a sudden disturbance of the electric fluid, previously at rest, would take place, and a violent rush of the current would as suddenly follow.

It is in this manner that shocks and sparks are produced by magnetic electric machines, where the current, previously in rapid motion, is suddenly transferred to a new channel of inferior conducting character; and all the fluid in the revolving coil rushes through a person properly situated for the new route, and who experiences the electric shock, or else through a thin stratum of air at an interruption in the metallic circuit where the spark is produced.

These, then, are some of the effects of electric currents, or of the momentum of the electric fluid in a state of motion, after the exciting cause is entirely cut off. The shock thus produced may very conveniently be compared to the blow given by Montgolfier's hydraulic ram. Electro-momenta may be produced by any mode of excitation whatever, and the effects will be proportional to the velocity and quantity of the electric fluid first put into motion; and the length of the original channel is also to be taken into account. If then electro-momenta, capable of producing violent shocks and vivid sparks, can be produced by a few hundreds of feet of thin copper wire, what is it that might not be expected from the electro-momenta of nature, arising from currents of many miles in extent, kept in motion either by heat, saline solutions, or by other causes, amongst the metalline strata below the surface of the earth? A sudden disruption in the circuit would insure the blow, and an earthquake might be the result. —*Philosophical Magazine*, 1836.

ON THE POSITION OF THE SOUTH MAGNETIC POLE.

By Edward Rudge, Esq., F.R.S., S. A., L.S. and H.S *

The experiments detailed by Captain James Clark Ross, R.N., &c., which led to the important discovery of the north magnetic pole, and which are published in the Philosophical Transactions for the year 1834, suggested to me as an object of interesting inquiry, whether any similar affection of the horizontal magnetic needle had ever been noticed by any former navigator of the *southern* hemisphere, from which an approach to the magnetic *south* pole could be surmised. No such appearances seem to have been observed by Anson, or any one after him; but prior to his circumnavigation of the globe, Captain Abel Tasman, who was appointed for the discovery of southern countries by direction of the Dutch East India Company, sailed from Batavia with two vessels on the 14th of August 1642, in his account of the voyage, gives the following particulars of an observation made on the 22nd of November of the same year, when, by a prior and subsequent observation of November the 15th and 24th, he was in about latitude 43°½ S., and longitude from Paris 160°.

"The needle was in continual motion without resting upon any of the eight points of the compass," which he says, "led him to conjecture that there were some mines of loadstone on that spot."

Tasman's Journal, written in Low Dutch, is now an extremely rare book: a translation of it is given in Dr. Hooke's Philosophical Tracts, p. 179, for the year 1682; in Narborough's and in Correal's Collections of Voyages; and also by Harris, who gives a new translation of it in the second edition of his Collection of Voyages, where, although he notices Dr. Halley's theory of the magnetic poles, which was published in 1683, he does not seem to suspect that Tasman's observation of this very remarkable affection of the magnetic needle was made in the immediate vicinity of the *south magnetic pole*, at that period in that particular situation, ascertained by the horizontal needle only; the dipping-needle, invented by Norman in 1681, being then unknown. Dr. Halley was of opinion that the north magnetic pole was not far from Baffin's Bay, and that the south magnetic pole was in the Indian Ocean, south-west from New Zealand; whether he had availed himself of the observation made by Tasman in forming this opinion, does not appear. Euler places the north magnetic pole for the year 1757 in latitude 76° north, and longitude 96° west from Teneriffe; and the south magnetic pole in latitude 58° south, and longitude 158° west from Teneriffe.

It has been ascertained by observation, that the magnetic poles were on the meridian of the poles of the earth at London in the year 1657, being fifteen years after Tasman's observations, and that it reached its utmost degree of variation west in the year 1818, when it became stationary at 24° 26′ west, and has since in respect of London been retrograding towards the east, completing one quarter of the circle round the poles of the earth in 161 years at the rate of 11 or 12 minutes of a degree in a year; so that, presuming Tasman was on the south magnetic

* Read before the Royal Society, Feb. 19, 1835; and now communicated by the Author.

pole on the 22nd of November 1642, it would now be found in or about the forty-third parallel of south latitude to the south-east of the island of Madagascar, a convenient situation, when compared with that of the north magnetic pole for ascertaining the exact position of the south magnetic pole, and where experiments with the horizontal and dipping-needles to lead to its discovery and determine the comparative intensity of the south magnetic power might with facility be made. In pursuance of this desirable object the progress of the south magnetic pole might be accurately ascertained by annual observations; whether its distance from the south pole of the earth is uniform in its progress and if in an exact opposite direction to the north magnetic pole; to trace the point at which the axis of the magnetic poles crosses that of the earth; and thus by a continued series of observations and experiments a wide field might be opened to enlarge our hitherto imperfect knowledge of this mysterious power, which might be considered of so much importance in guiding and directing the motion of the earth on its axis and in its orbit.

TABLE OF THE OBSERVATIONS ON THE MAGNETIC NEEDLE MADE BY CAPTAIN JOHN ABEL TASMAN FROM THE BEGINNING TO THE TERMINATION OF HIS VOYAGE; EXTRACTED FROM HIS JOURNAL.

Time.		Latitude.	Longitude from Paris.	Variation of the Needle.	
1642.					
October 8 to	22.	40°40'S.	....	23°24°&2°5°W	
	22.	49 47	89°44'	26° 45 W.	
Nov.	6.	49 4	114 56	26	
	15.	44 3	140 32	18 30 W.	
	21.	....	158	4 W.	
	22.	....	....	....	The needle in continual agitation.
	24.	42 25	163 50	....	The needle pointed towards the land now first discovered and called Van Diemen's Land.
Dec.	1.	43 10	167 55	3 E.	Frederick Henry bay. Van Diemen's Land,
	9.	42 37	176 29	5 E.	New Zealand.
	18.	40 50	191 41	9 E.	
1643.					
January	8.	30 25	192 20	9 E.	
	12.	30 5	195 27	9 30 E.	
	16.	26 29	199 32	8 E.	
	19.	22 35	204 15	7 30 E.	
	21.	21 20	205 29	7 25 E.	
	25.	20 15	206 19	6 20 E.	
March	2.	9 11	192 46	10 E.	
	14.	10 12	186 14	8 45 E.	
	20.	5 15	181 16	9 E.	
	25.	4 35	175 10	9 30 E.	
April	1.	4 30	171 2	8 45 E.	
	12.	3 45	167	10 E.	
	14.	5 27	166 57	9 15 E.	
	20.	5 4	164 27	8 30 E.	
May	12.	0 54	153 17	6 30 E.	
	18.	0 26	147 55	5 30 E.	
	27.	6 12 S.	127 18	Returned to Batavia after 10 months' absence, having sailed round the Australian continent without seeing any part of it but the extremity of Van Diemen's Land.	

[*Philosophical Magazine, for* 1836.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY. 1836.

Specimens were exhibited of numerous *Shells* of the genus *Mitra*, Lam., and of one species of *Conœlix*, Swains., forming part of the collection of Mr. Cuming; and an account of them by Mr. Broderip was read, commencing as follows:

"The species of the genus *Mitra*, Lam., which I am about to describe, had been sent by Mr. Cuming, in whose cabinet they are, to Mr. Swainson, whose intimate acquaintance with this family renders him so particularly competent to the task of describing them. They were named by him, and he also made notes respecting them before returning them. In the following account of them I have retained Mr. Swainson's name in every instance but one: and whenever he has made any written observations I have quoted them.

Characters, habitats, &c. of the following species were then given, and are printed in the "Proceedings."

Genus Mitra (*Lam.* and *Swains.*). *Mitra nebulosa* (representing *nubila*, Type 5, 1, Sw.), *Swainsonii* (Type 1, 1.), *Ancillides* (5, (2 ?), *maura* (representing *Tiara foraminata*, Type (1, 4.), *fulvescens* (5, 1.), *testacea* (5, 1. representing *fulva*), *fulva* var. (1, 2. representing *Tiara*1, *chrysostoma* (5,). representing *ferruginea*), *tristis* (2, 4.), and *effusa* (1, 5.).

Genus Tiara, *Swains.* (Mitra, Lam.) *Tiara foraminata* (representing *Mitra maura*, Type 2, 4), *muricata*, *mucronata*, *catenata* (1, 3.), *multicostata*, *rosea* (1, 2), *millecostata* (the close-set longitudinal ribs and cancellated base give this shell, which may not have attained its full growth, the aspect of a *Cancellaria*), *lineata* (5, 1), *nivea* (5, 3.), *aurantia*, *terebralis*, *crenata* (5,3, or 3, 3.), *rubra* (1, 2.), *semiplicata*, and *attenuata* (5, 1).

Mr. Swainson had written on the paper containing *Tiara terebralis*, "Type 4,4. This is one of the most extraordinary shells in the collection, as it so closely resembles the *Mitra Terebralis* that, but for its possessing the generic characters of *Tiara*, it might pass for the same species.

It is one of the most slender of its genus, and has very much of the general character and form of a *Terebra*; and its resemblance to *Terebra* is increased by the circumstance of its having one spiral groove, more deeply impressed than the others, placed at about one third of the length of each volution before the suture. The points of contact of the decussating with the longitudinal grooves are deeply impressed.

There is a fine specimen in Mr. Broderip's collection.

Mr. Sowerby has furnished me with the account of this species.

Genus Conoelix (*Swains.*). *Conoelix Virgo* (representing *Conus Virgo*).

The following observations by Mr. Swainson elucidate his notes in relation to the *Mitres*, appended to most of the characters of the shells above named:

"To render my explanation of the notes and references attached to the different species of the *Mitranæ* more intelligible to conchologists, it will be necessary for me to state, in as few words as possible, the result of my investigation of this subfamily, and the principles which have regulated these numerical indications.

"I have already, in another work, characterized the family *Volutidæ*, which appears to be that primary division of the *Carnivorous Gasteropoda* (*Zoophaga*, Lam.), which represents the *Rasorial* type among *Birds*, the *Ungulata* among *Quadrupeds*, and the *Thysanura* among perfect *Insects* (*Ptilota*): these analogies being of course remote, although founded on the structure of the animal, no less than on its testaceous covering. It thus follows that the Lamarckian *Mitræ*, instead of a genus, constitute a subfamily, which appears to be the subtypical group of the circle. The five genera composing this circle I have long ago characterized; and here, for some years, my analysis of the group terminated. The inspection, however, of the numerous species brought home by Mr. Cuming, and the gradually augmented number in my own cabinet, seemed to invite a still further and more minute investigation, for the purpose of ascertaining if any, and what, subgenera were contained in the more crowded groups of *Mitra* and *Tiara*. This investigation was carried on, at intervals, for nearly twelve months; and the result surpassed my most sanguine expectations. It has convinced me that not only does each of the genera of the *Mitranæ* represent analogically the corresponding groups of the *Volutinæ*, but that the same relations can be demonstrated between the minor divisions of the genera *Tiara* and those of *Mitra*: in other words, that these latter represent all the subfamilies and genera of the other *Volutidæ*, while they preserve their own peculiar or generic character. What I have just said on the parallel relations of analogy between the *Mitranæ* and the *Volutidæ*, is strictly applicable, in fact, to the genera *Mitra* and *Tiara*, the primary divisions of each of which can thus be demonstrated subgenera. Nor is this all: the materials I have been for so many years collecting have enabled me to ascertain, in very many instances, that the variation of the species, in each of these subgenera, is regulated on precisely the same principle. Hence it follows that the two circles of *Mitra* and *Tiara*, like the two divisions of Mr. MacLeay's *Petalocera*, contain species representing each other, so that if their generic character is not attended to, it is almost impossible to discriminate them even as species. Many instances of this extraordinary analogy might be mentioned, independent of that here alluded to, between *Mitra Terebralis* and *Tiara Terebralis*.

"Selecting this shell to illustrate the numbers "Type 4, 4," I may observe, that 'Type 4' signifies that it belongs to the

fourth subgenus of *Tiara*, in which group it is the fourth subtype, uniting to *Mitra maura*, which is the fourth subtype of the first or typical subgenus. *Mitra maura*, again, as representing this latter shell, consequently becomes the fourth subtype of the first or typical subgenus, and is therefore marked "Type I. 4." The first figure always denotes the subgenus, and the last the station which the species appears to hold in its own subgenus.

"I am unacquainted with any group in the animal kingdom which demonstrates more fully than this does the law of representation. It may be mentioned, also, that nearly all the divisions I had long ago characterized, from the formation of the shells alone, have more recently been confirmed by a knowledge of their respective animals: a knowledge for which we are entirely indebted to the able naturalists who accompanied the French expedition on board the Astrolabe."—W. S.

Specimens were exhibited of several hitherto undescribed *Cowries*, most of which have been brought to England within the last few years. They were accompanied by characters and descriptions, by J. S. Gaskoin, Esq., which are given in the "Proceedings" under the following names, viz.

Cypræa formosa (Cape of Good Hope), *rubinicolor*, *producta*, *candidula* (Mexico. *Cyp. approximans*, Beck, *Cyp. olorina* Duclos, but first described by Mr. Gaskoin), *acutidentata* (Isle of Muerte, Bay of Guayaquil), *Pediculus*, var. labiosa, *vesicularis* (Cape of Good Hope), and *Beckii.*

There was read an "Extrait du Quatrième Rapport Annuel sur les Travaux de la Société d'Histoire Naturelle de l'Ile Maurice: par M. Julien Desjardins."

The communications relative to the *Mammalia* read before the Natural History Society of the Mauritius in the fourth year of its existence have comprised an account, by the secretary, M. Julien Desjardins, of a *Whale* which he regards as the *Physeter macrocephalus*, Linn., that was cast ashore on an adjoining reaf: and some observations by the same author on several of the *Mammalia* of the island, and particularly on the hybernation of the *Tenrec*, *Centenes spinosus*, Ill.; the lethargy of which animal takes place when the thermometer is not lower than 20° Cent., and even when it marks 26°.

In ornithology M. Desjardins has also been the only contributor. He has described, as new, two *Birds* belonging to the island, and has proposed for them the names of *Charadrius Nesogallicus* and *Scolopax elegans*.

M. Liénard, the elder, has, in the course of the year, described many *Fishes*, including a new species of *Plectropoma*, allied to the *Plectr. melanoleuca*, Cuv. & Val., which is of a uniform brown colour, with all its fins of a still deeper brown, except the pectora which are orange; on this latter character his specific name is founded: a *Holacanthus*, La Cép., from Batavia, remarkable on account of the numerous sinuous silvery lines which occupy principally the middle of the body; and having also on its face two yellow and two black bands, one of which is ocular: a *Cheilinus*, Cuv.: an *Echeneis*, Linn., furnished, on its suctorial disc, with twenty-five hairs of plates: and a *Murœna*, Thunb., the body of which is of an ebony black, and the dorsal fin yellow; the trivial name being indicative of the latter peculiarity He has also given some account of a collection of *Fishes* obtained from the western coast of Madagascar, and comprising thirteen species, several of which he regards as new. M. Desjardins has described as the *blue-faced Tetrodon*, a species remarkable for two large blue spots on each side of its face, and having the fin-rays as follows; D. 15 a. A. 12. P. 14. C. 14.; it inhabits the seas adjacent to the Isle of France.

In entomology the only communication made to the Mauritius Society was by M. Goudot, and related to the *Insect* described by Mr. Bennet at the Meeting of the Zoological Society on January 22, 1833, (Proceedings, Part i., p. 12; Lond. and Edinb. Phil. Mag., vol. ii. p. 478,) under the name of *Aphrophora Goudoti.* The communication made to the Zoological Society, of which a full abstract is given at the page quoted, was apparently identical with that read before the Mauritius Society.

The remaining zoological communication related to the *Intestinal Worms*, and was made by the Secretary. It gave some account of the *Distoma hepaticum*, Cuv., as found in the stomach of a cow; and of the *Cysticercus Cellulosæ*, Brems., existing in innumerable quantities over almost the whole of the head, trunk, and extremities of a sow.

An "Extrait du Cinquième Rapport Annuel" of the same Soeiety, by M. Julien Desjardins, Corr. Memb. Z. S., was also read.

In the year of which the present Report gives an account, M. Desjardins has communicated to the Natural History Society of the Mauritius, a list of several species of *Birds* that are occasional visitors of that island; and has also referred particularly to the *Coturnix Sinensis*, Cuv., and the *Nectarinia Borbonica*, Ill., as stationary in the Mauritius.

M. E. Liénard has brought from the Seychelles a species of *Gecko* of considerable size, which he has described in a communication made to the Society: and M. E. Liénard has placed on record the existence in the adjacent seas of the *Sphargis coriaceus*, Merr.

M. Liénard, the elder, has again made numerous contributions to ichthyology. He has given a detailed description of the *Squalus Vulpes*. Linn.: has described as new a *Trichiurus*, Linn., which he had formerly regarded as the *Trich. lepturus*, Ej., but which has the eye much larger, more numerous *striæ* on the *suboperculum*, and a few more rays in the dorsal fin: and has also described two species of *Crenilabrus*, Cuv., which he regards as new; one of them has three longitudinal rose-coloured bands on the white ground of the body, others on the dorsal

fin, a large blood-red red spot on the ventral fins, and D. 12 × 10 A. 3 × 11; the other is banded like the preceding, but is deeply rose-coloured on the back and pale yellow below, has a black circle surrounding the base of the pectoral fin, a large red spot above the *anus*, the dorsal and caudal fins red, the anal and ventrals yellow, the pectorals rose-coloured, and D. 12 × 9, A. 3 × 11. He has also given a description of a *Murœna*, Thunb., of a very pale olive yellow towards the front and brown towards the tail, and marked on the back by white ocellated spots bordered with brown.

In the same department M. E. Liénard has contributed descriptions, from recent specimens, of several *Serrani* described by Cuvier and M. Valenciennes in their 'Histoire Naturelle des Poissons'; and has also given a description of a *Blennius*, Linn., destitute of appendages on the head. These fishes were observed in a voyage to the Seychelle Islands whence M. E Liénard brought back with him to the Mauritius a *Chœtodon* of very varied colours. which M. A. Lienard subsequently described under the name of *Chœtodon diversicolor*. M. Desjardins has stated, in a note, that the *Mango fish*, *Polynemus longifilis*, Cuv. & Val., is not found, as had been announced, in the Isle of France. And he adds that he has prepared an alphabetical index to the nine volumes of the 'Histoire Naturelle des Poissons' that had then reached the Mauritius. M. Magon has presented to the Museum of the Society a fragment of a ship's coppered keel pierced by the point of the upper jaw of a *Histiophorus*, Cuv., which still remains infixed in it.

M. Desjardins has contributed the only notices relative to the *Mollusca* which have consisted of short descriptions of three species belonging to the island: an *Octopus Oct. arenarius*, Desj., found in the shell of a *Dolium*; a *Pupa*, of a red and yellow colour; and a small species of *Helicina*. He has also ascertained the existence at the Mauritius of the *Tornatella flammea*, Auct.

To the same active member the Mauritius Natural History Society is indebted for the only entomological communication made to it in the fifth year of its existence; it is a detailed description of a large species of *Iulus* brought from the Seychelles, and characterized as the *Iulus Seychellarum*, Desj.

Specimens were exhibited of various *Fishes*, forming part of a collection from Mauritius, presented to the Society by M. Julien Desjardins, and forwarded by him at the same time with the "Rapports de la Société d' Histoire Naturelle de l'Ile Maurice." These were severally brought under the notice of the Meeting by Mr. Bennett, who called particular attention to the following, which he regarded as hitherto undescribed, and of which the characters are given in the "Proceedings." viz.

Apogon *tœniopterus*; Acanthurus *Desjardinii, Ruppelii,* and *Blochii*? Labrus *spilonotus*; and Anampses *lineolatus*.

(*To be continued.*)

THE INDIA REVIEW.

Calcutta: February 15, 1837.

ROADS AND PUBLIC WORKS IN INDIA.

Much has been recently mooted by the press on the subject of roads. As we are in possession of an official abstract statement of all important public works which have been constructed in India or are at present in progress, such as canals or roads, since the renewal of the former East India Company's charter, we proceed to show how far our rule has promoted commercial intercourse by supplying the important desiderata, especially the want of roads: observe for instance the remarkable work which has, we believe, been completed,—we mean the construction in 1812 of a road from Calcutta to Juggurnauth, upwards of 300 miles in length, with branches to the principal towns near which it passes. It is rather unfortunate for those who would plead this work as proof that commercial intercourse has been encouraged, that this road leads to the foulest sink of idolatry ever exhibited in any known part of the world. The following however is the abstract of the monuments of British improvements from 1813 to 1831.

1813:

The excavation of a canal, connecting the Ganges and Bugruttee rivers: completed.

Operations for the improvement of the navigation of the Nuddea rivers, by dredging, removal of rocks, &c.: still continued in every dry season.

1814:

The erection of two bridges on the estates of Rajah Ram Dyal Sing.

The excavation of a tank and erection of a bridge in Meerut.

Repair of the Ahmednuggur aqueduct.

Cutting the western end of the nullah to the bridge at Gobra near Moorshedabad; completing the eastern cut, and filling up the road across the old nullah.

Construction of a building for Divine worship at Meerut.

Construction of a pucka road, ten arched drains across certain roads, and a pucka ghaut to a tank in the Cooley Bazar.

The military road from Calcutta to Benares restored to its original width, repaired, and several small bridges erected; the road also continued to Range Ghaut.

Construction of a pucka road from Allahabad to Burdwan.

Raising and repairing a road from Puttah Ghaut, which joins the military road near Hurripaul.

1815 :

Laying down mooring chains, and construction of a depôt for marine stores at Saugor.

Completion of the town hall.

Erection of a mausoleum at Ghazeepore, to the memory of Marquis Cornwallis.

Erection of lighthouses at Saugor Island, Point Palmyras, and certain floating lights there; likewise of one at the island of Moyapoor. (In 1821 the construction of the lighthouse at Saugor was abandoned, and one on Edmonstone's Island authorized in its stead; which was also afterwards abandoned, and a second lighthouse on Moyapoor constructed.)

Building a bridge over the nullah at Meerut.

Cutting a road twelve feet wide for beasts of burthen from Bumouree to Almorah, and building bridges.

1816 :

The clearing of the island of Saugor, authorised.

Rebuilding the houses of the botanical garden.

Establishment of a native hospital at Patna

Erection of a lighthouse at Kedgeree.

Repairs and alterations to the government houses at Calcutta, and in the park at Barrackpore, and erecting guard-rooms and stabling for the body guard: completed in 1827.

1817 :

Repair of an ancient aqueduct in the Deyra Dhoon.

Restoration of the Delhi canal: completed.

Restoration of a canal in Goruckpore.

Construction of a new road at Moochucollah.

Erection of telegraphs between Calcutta and Nagpore.

Construction of a road from Tondah to Bumouree.

Completion of the new road from Patna to Gyah.

The road from Puttah Ghaut to the military road near Hurripaul widened.

1818 :

Eight bridges built for the entrances on the land side of the city of Delhi.

The road repaired between Mahratta bridge, Calcutta, and a bridge connecting the main road with the gate of the hospital at Dum Dum.

Construction of a well in the centre of the proposed Gunge at Bumouree and Tondah (this work was in 1820 abandoned, in consequence of the unhealthiness of the situation); road leading from Calcutta to Dum Dum repaired.

Construction of a road from Puttah Ghaut to Hurripaul.

The road between Patna and Shehargotty raised, and drains and watercourses added for the purpose of promoting cultivation.

1819 :

Construction of a chapel at Benares.

Extension as far as Ruderpore of the road constructed from Bumouree to Tondah in Kumaoon, for the purpose of opening a communication between the Plains and Almorah.

Repairing the bridge over the Ramgunga, and constructing a new bridge over the Soorjoo rivers in Kumaoon.

1820 :

Erection of an exchange by the merchants of Calcutta on a site of ground granted by government.

Formation of a botanical garden at Saharunpore.

Construction of part of a road from the Barrackpore cantonments to a spot opposite the village of Buddee Pautee, where limekilns have been constructed.

Construction of sangha bridges over the Bulleah and Soowal rivers in Kumaoon.

Sinking two pucka wells at Deyrah in the Dhoon.

1821 :

Measures for building a Scotch church (St. Andrew's), and a grant of government in aid of its erection, which was completed in 1824.

Erection of two chapels at Benares and Dacca; also,

Completion of a new chapel at Futtyghur.

Construction of a church at Fort William, and of a new chapel at Calcutta.

Measures adopted for improving the routes of communication between the principal positions of the army, by opening and repairing roads at and between the following stations, so as to make them available during the dry season for any description of transport carriage; *viz.*

From Agra to Mhow *viâ* Lakheree and Mokundiah.

From Mhow to Delhi, by Neemutch and Nusseerabad.

From Asseerghur to Hussingabad, thence to Mhow *viâ* Mundlasir, and to Nagpore *viâ* Berhampore and Ellichpoor.

From Cawnpore to Saugor through Bundlecund, and thence to Nagpore by two routes, *viz.* by Jubblepore, and by Hussingabad.

From Calcutta to Nagpore, through the Singboom country.

1822 :

Excavation of a canal to unite the Hooghly with the Ganges, through the Salt-water Lake. (This work was proposed in this year, and the line surveyed, but the operations were only commenced in 1829.)

Additional moorings laid down at Kedgeree.

Measures for the survey and improvement of the port of Cuttack.

Arrangement respecting the moorings laid down off the esplanade for government vessels, sanctioned.

Formation of a teak and sissoo plantations at Bauleah, Sylhet, and the Jungle Mehals.

Construction of a line of telegraphs from Fort William to Chunar.

Construction of a road from Chilkea to Howel Baugh in Kumaoon for mules and tatoos for commercial purposes, and more particularly for facilitating the commerce between Tartary and the Plains.

Three new sangha bridges built, and a fourth reconstructed, over the rivers in the Kumaoon district.

Increased means employed for making a part of the new road from Calcutta to Nagpore *viâ* Sumbulpore.

Construction to Puttah of the new road from Barrackpore to Buddy Pautee.

1823:

Construction of a hospital for the pilgrims resorting to Juggurnaut.

Excavation of a canal to unite the Damra and Churramunnee rivers: still in progress.

Re-opening of Feroze Shah's canal in Delhi: completed.

Restoration of Zabita Khan's canal in the Upper Dooab.

The course of Ali Murdher's canal drawn into Delhi.

Works on the Seetabuldee hills.

Construction of buildings on the eastern bank of the Hooghly, and of pucka pillars as beacons to be made subservient to telegraphic communication.

Execution of certain works at Diamond Harbour; moorings at the new anchorage; bridle chains and spiral buoys for the anchorage westward of the Kanacka river.

Erection of a new mint at Calcutta: now in progress.

1824:

Wooden bridge built across the river Pabur at Raeen; military road between Nagpore and Ryepore.

Erection of a chapel at Dum Dum, and another at Meerut.

Construction of two churches at Cawnpore.

Erection of a church at Dacca.

Erection of an additional church at Calcutta.

Erection of a church at Burdwan.

The Cutcha sides of the road from Dum Dum to Shaum Bazar bridge, raised and turfed; revetments of timber and planking as an embankment to the Ganges at Dinapore, to preserve public buildings.

Construction of two new tanks at Nusseerabad.

Construction of a new road from Mirzapore to Saugor, Jubbulpore, Nagpore, and Omrawatty to Bhopalpore, Mhow, &c.

1825:

Establishment of a botanical garden at Singapore; erection of bungalows and seraies for travellers in the military road from Calcutta to Benares.

Replacing certain bunds destroyed by the torrents from the Damooda river, and repairing the damage done to the military roads between Hurripaul and the eastern bank of the river.

A road constructed from Cuttack to Padamoondy or Aliva; particularly desirable for the transit of military stores at all seasons.

Two pucka bridges over two nullahs on the road to Jaugemow at Cawnpore.

1826:

Erection of a new Madrissa, or Mahomedan college, in Calcutta.

Erection of a new Sanscrit college in Calcutta.

Construction of a new dawk road between the presidency and the new anchorage.

Construction of rope suspension bridges, known afterwards as "Shakesperian Bridges," was first introduced.

Additions, alterations, and repairs to the Lower Orphan School at Allipore.

Construction of two bridges over the Singhea Khal, and Sodepore Khal nullahs, on the new Benares road.

1827:

Improvements of the dawk road, through Shakespeare's Pass to Channel Creek, and the construction of a Shakesperian bridge over the Kowar Torrent on the Benares road.

A new building for the Madrissa or Mahomedan college.

Erection of the Hindoo college: completed.

Four Shakesperian bridges thrown over the Ramgunga, Kummee, and Ramghur rivers.

1828:

Operations for the removal of the rocks which obstruct the navigation of the Jumna: still in progress.

Erection of staging bungalows on the road from Shergotty to Gya, and thence to Patna.

Erection of an asylum at Benares for the destitute and blind, by Rajah Kali Shunker Ghosaul, the expences of which in part are to be defrayed by government.

Construction of three beacons towards the eastern end of the Straits of Malacca.

Construction of a bridge and boundary pillars at Agra.

Nine iron chain bridges thrown over the rivers in the province of Kumaoon.

1829:

The formation of roads in the districts of Jounsai and Bhowar.

Construction of a road from Balasore to the sea-beach.

1830:

Formation of a new road from Cuttack to Ganjam *viâ* Khoordah, intended as a high road of communication between Bengal and Fort St. George: in progress.

Construction of the Jynta road.

A road to be constructed *viâ* Hooghly and Burdwan to Bancoorah: now in progress.

Staging bungalows and seraies at Gopeegunge, Allahabad, Shajadpore, Futteepore, Cawnpore, Koostan, and Gya: now in progress.

Telegraphic towers on the semaphore principle at Kedgeree lighthouse, Coverdale's Tree, Mud Point, Moyapoor, Fort William, and at Middle and Diamond Points: now in progress.

Two pucka wells constructed at Meerut, one for the use of the natives, and for watering the roads of cantonments; and the other for the use of the public libraries.

Construction of a small bridge of masonry over a branch of the Nucteah nullah, near Bareilly; also bunds for securing the east bank of the same nullah.

1831:
The "Strand Road" at Calcutta, towards the completion of which, Court's contribution has been requested."

In our next we shall notice the public works in Madras and Bombay, as well as the surveys which have been effected.

BORING.—FORT WILLIAM.

A brass plumb by the breaking of the string having remained at the bottom of the tubes used for the artesian spring in Fort William, among other means adopted to bring it up, a mud shell-augur was used to push it out of the way or to raise it; having laid hold of it, the force required to bring it up was so great as to break the shoulders of the instrument. The Sappers and Miners, we are happy to say, have succeeded in bringing it up from a depth of 326 feet, by breaking of the valve at B. (see plate VI, fig. 14 and 15,) and disengaging the plumb by means of a jumper, after which the conical worm-augur laid hold of the hinge of the valve of the mud shell-augur, the cutters of which were broken off.

The greatest praise is due to the Sappers who superintended, for their unremitting attention to the work. It is believed no damage has been done to the tubes, and we have no doubt, by the same talent and perseverance which have been hitherto evinced in this great scientific undertaking, that they will now get to the depth at which water will be found.

LIKENESSES OF DISTINGUISHED INDIVIDUALS.

We have in our possession some very correct likenesses of distinguished individuals who have lately left India, and of others who are still residing in this country: we shall give one or two every month.

There are some persons to whom deep scientific research and mechanical discoveries have no particular allurements. By making our publication interesting in every particular, we hope to win them to the love of studies of not less importance to themselves than to the community at large.

FLOUR-MAKING RECOMMENDED AS AN EMPLOYMENT FOR THE POOR.

We beg to call the attention of the Government and the District Charitable Committee to Hebert's flour-maker, described in our present number and illustrated by a drawing. It appears to us that much good would be effected, were the prisoners now in our native jails employed in flour and rope, rather than in road-making,on which, in our opinion, proper work people alone should be employed.

To guard against the imposition of those who prefer idleness to industry, we conceive Hebert's flour-maker might be used by the District Charitable Committee as profitable occupation for such as are dependant upon its bounty, on account of not obtaining employment elsewhere. Were the society to which we allude to rent a work-house, rope-making, cotton-spining, and other profitable labour might be introduced, and large returns for their present expenditure secured, and by extending such means of doing good give a moral character to the people and enforce permanent habits of industry and a thirst for improvement.

LORD AUCKLAND'S FOURTH SCIENTIFIC PARTY.

January 14, 1837.

At this meeting Dr. O'Shaughnessy performed part of the eigth series of Farraday's experimental researches, which will be found described at page 18 of our Review. He also exhibited, with much better effect than on the former occasion, his working model of a machine, producing moving power by the application of electro-magnetic influence. Several splendid specimens of fossils were on the table, especially those considered to be new genera, others which Captain Cautley and Dr. Falconer have called *sevatherium*, found by them in the Sewalik hills.

There were several mineralogical specimens from New South Wales, also some birds collected by Mr. Cracroft; among the latter was a beautiful specimen of the white hawk. From Mr. Irwin a fine specimen of the ornithorynchus. Two boxes exhibiting numerous kinds of timber collected at Tavoy by T. Maingy, Esq. Upon the same table were displayed some highly finished drawings of fishes peculiar to India, by Dr. Cantor.

PROGRESS OF SCIENCE,

AS APPLICABLE TO THE ARTS AND MANUFACTURES; TO COMMERCE AND TO AGRICULTURE.

TO JOHN HEATHCOAT, OF TIVERTON, IN THE COUNTY OF DEVON, ESQ., FOR HIS INVENTION OF CERTAIN NEW AND IMPROVED METHODS OF DRAINING AND CULTIVATING LAND, AND NEW OR IMPROVED MACHINERY AND APPARATUS APPLICABLE THERETO; WHICH MACHINERY AND APPARATUS MAY BE APPLIED TO DIVERS OTHER USEFUL PURPOSES.

Sealed 15th May, 1832.

The subject of this patent is, in a national point of view, particularly as regards Ireland, one of the most important that has been introduced to the public. It is principally designed to afford the means of cultivating such boggy waste lands as are of too spongy a character to sustain the feet of horses.

The apparatus consists principally of a locomotive steam-engine sustained upon a platform, which moves very slowly over the surface of the bog, upon a very broad endless band, which is nearly impervious to water, and presents such an extended surface as to prevent its sinking. From this machine ploughs and other implements of husbandry for cutting and turning over the surface of the moss are worked out and in, to the distance of a quarter of a mile on each side at right angles to the course in which the engine is slowly advancing, and the power of the steam impels the ploughs in place of horse or other manual labour.

Upon the merits of this invention and its important advantages volumes might be written, and no doubt will be; but our limits at present only allow us to give the details of the contrivances as set out in the specification, observing, however, that we have withheld our report under the expectation of being enabled to speak practically of the effect of its operation.

We have several times within the last two years witnessed the action of the machinery upon Red Moss, near Bolton-le-Moors, in Lancashire, under the superintendence of a skilful engineer, Mr. Josiah Parks, and have now the satisfaction of communicating to our readers the fact of its most unqualified success.

The new or improved methods of draining and cultivating land, consists in the employment of certain machinery and apparatus to be worked by steam or other power, for the purpose of ploughing, cutting, rolling, harrowing, trenching, and draining lands, and for effecting other operations of husbandry as are or may be performed by traction, which machinery and apparatus is particularly adapted for use on lands which cannot be so conveniently worked and tilled in the ordinary manner by the agency of horses or other cattle.

This machinery or apparatus consists of a carriage with a steam-engine, or other motive engine mounted thereon; and also of auxiliary machines or apparatus, supporting and conducting extended ropes, bands, or chains, at a distance from the motive engine.

The power of the engine is designed to to draw ploughs and other agricultural implements to and fro, between the principal and auxiliary carriages at right angles, or any other convenient angles, and also to give locomotion to the principal carriage in which the engine is mounted.

In order to render my methods more evident, I shall proceed to describe the general features of my machinery or apparatus, with the objects they are intended to effect, and some of the variations and modifications of which they are susceptible.

First, I employ a carriage of large dimensions, designed for the support of a steam-engine, or other machinery, capable of

generating or communicating motive power ; this carriage is mounted on a series of wheels, which conduct an endless flexible floor rail-road or way, within and upon which the carriage travels.

The endless flexible floor, rail-road, or way, affords an extremely broad and extended surface, for the purpose of sustaining a carriage of great weight upon soft, swampy, boggy, or unstable land.

Secondly, in place of the series of wheels and broad flexible endless floor, rail-road, or way, I substitute, in certain cases, rollers or drums, presenting considerable surfaces to the ground ; I employ carriages mounted on such broad rollers or drums on lands or soils which naturally possess or have acquired sufficient solidity to sustain their weight.

Thirdly, I modify the carriage by mounting it upon wheels suitable for travelling on land of a sufficiently firm and compact nature, in order to simplify the application of the machinery and apparatus to the culture of such soils.

Fourthly, I employ auxiliary carriages, which I place on each side of the principal carriage, at a distance from and parallel therewith, and by means of ropes, bands, chains, or other media of traction, issuing from and actuated by the machinery of the principal carriage ; and passing round a wheel, pulley, or barrel, on the auxiliary carriages, I drag the ploughs or other agricultural implements to and fro between the said principal carriage and auxiliary carriages at right angles, or at any other convenient angles, to the line of progress of the principal carriage. By these means, a wide extent of land is brought under operation by my machinery and apparatus.

These auxiliary carriages are mounted on wheels, rollers, drums, or flexible floors, rail-roads, or ways, similar to those provided for the principal carriage, and suitable to various soils, by which means they are capable of being made to advance or retrograde as circumstances may requrie.

Upon the platform of the principal carriage described under the first, second, and third heads, I fix a boiler and the several parts of a steam-engine or other actuating machinery, which, through the agency of wheels and suitable gearing, I employ for the purpose of giving locomotion to the carriage in its longitudinal direction, and also for driving the drums or barrels, that work the track ropes, bands, or chains, which draw the ploughs or other implements to and fro between the principal carriage and the auxiliary carriage.

In the accompanying drawings, see Plate 5, the same letters are used to denote similar parts in all the figures. Fig. 1, is a plan or horizontal view of the skeleton or frame of the principal carriage, showing twelve large wheels, *a*, *a*, *a*, and also twenty-four wheels, *b*, *b*, *b*, of smaller diameter, supporting the carriage. These wheels are fixed upon shafts lying transversely to the length of the carriage, the shafts of the larger wheels being mounted on pedestals standing upon the upper beams or timbers, of which the framing of the carriage is constructed, and those of the smaller wheels turning in pedestals fixed on the lower beams of the framing.

Round the six wheels *a*, *a*, *a*, and under the twelve smaller wheels *b*, *b*, *b*, on each side of the carriage, an endless flexible floor is extended, the upper part being removed in this figure the better to show the parts ; the weight of the upper part of these floors being sustained in the middle by wheels placed at suitable distances, to allow the iron plates of the endless floor, hereinafter described, to rest upon and pass over them, as shown in the side elevation of the locomotive engine at fig. 3, and which wheels are supported from the platform of the carriage.

This endless flexible floor *c*, *c*, *c*, I propose to make of painted or tarred sailcloth, which is stretched transversely by the bars of wood *d*, *d*, bolted at intervals to endless strips of sheet iron *e*, *e*, upon which strips or bands of iron the wheels run.

The heads of the bolts by which the stretchers are connected with the iron bands (excepting those which would come in contact with the teeth of the spire wheels *m*, and *n*,) are made so long as to project inwards about two inches ; the space between the heads of each pair of bolts is somewhat greater than the width of the rims of the wheels, and the insides of the heads are bevelled in order to allow the wheels to enter more freely between them. Thus the bolts serve not only to unite the several parts of the flexible floors, (that is to say) the endless iron bands and transverse wood stretchers with the sailcloth held firmly between them, but also to keep the iron bands in the tracks of the wheels.

In some cases I propose to dispense with the sailcloth, and in lieu thereof to use a greater number of wooden stretchers, placed as near to each other as may be necessary, in order to bear the weight of the carriage, and prevent its sinking too deeply into the land or soil. The construction of the endless flexible floor is represented in several of the annexed figures.

Fig. 2, is a horizontal view of the locomotive carriage, exhibiting the platform or floor on which the boiler, the engine, the gearing, and other machinery, are fixed.

In the side elevation, fig. 3, the boiler and one of the steam-engines, with its appendages, is exhibited; and in fig. 4, which is also a side elevation, the mode of mounting and driving one of the track rope barrels only is represented. Fig. 5, is an end view of the locomotive carriage and engine, exhibiting the endless flexible floors passing over the wheels.

The auxiliary carriage is shown in a plan or horizontal view at fig. 6, and in side elevation at fig. 7. It is mounted on broad rims or rollers, and exhibits the wheel or pulley round which the cord is passed from the principal carriage.

Fig. 8, is a plan or field view, upon a very minute scale, of the relative position of the principal and auxiliary carriages, as they are to be employed, together with the manner in which the power of the engine is communicated to the ploughs or other implements, through the agency of the track ropes, bands, or chains.

I intend, wherever the surface of the land operated upon shall permit, to make drains on each side of the track of the carriages, as represented in fig. 8, which drains will serve the double purpose of laying dry the roadways on which the carriages travel, and of receiving and discharging the water issuing from the drains which may require to be made between the parallel roadways of the principal and auxiliary carriages. These drains, being at right angles to the roadways, may be formed in part by the traction of draining ploughs, or other suitable implements of drainage, by the steam-engine, and their intersections with the roadway drains may be completed by hand labour. I also intend to lay down these roadways in grass or herbage, which will be benefitted, rather than injured, by the passage of the carriages over its surface. This application of my invention is more particularly suitable to bogs and mosses, which, from their extent, will admit of being laid on a plan of parallel roadways at given distances, crossed at right angles by similar roadways. These arrangements will prevent the expense of constructing hard stone roads: no land will be lost, as I contemplate that the cultivation, by my machinery and apparatus, of such lands, will be more economical and convenient than the employment of horses and other cattle, even after they shall have acquired sufficient solidity to bear horses or other cattle, and carriages of the ordinary description.

The steam-engine, which I deem most convenient for the purposes of this invention, is constructed upon the high-pressure principle, with two horizontal cylinders, which, through their connecting rods, give motion to the crank shaft.

The steam whereby the pistons are worked is generated in a boiler A, and passes from thence through pipes B, B, to the induction valves and cylinders C, C, which are furnished with suitable valves, and the eduction steam is discharged from the cylinders after each stroke by the pipes D, D, into the chimney E, E. The boiler is supplied with water by the force pumps F, F, worked by rods attached to the slides of the piston rods. The power of the engine is communicated to the machinery by which the carriage is moved, and also to the machinery designed to work the ploughs and other apparatus for draining and tilling the land, through the agency of the crank shaft *f*.

On the crank shaft *f*, there is a sliding pinion *g*, which, when thrown into gear with the wheel *h*, gives rotary motion to the train of wheels and pinions *h*, *i*, *k*, *l*; by which means the large spur wheel *m*, fixed on the shaft of the wheels *a*, *a*, will be driven round, and with it the wheels *a*, *a*, also.

Upon an elongation of the shaft of the pinion *l*, (which is broken off in the drawing, fig. 2, to avoid confusion, but shown by dots,) a similar pinion is fixed, which takes into the other spur wheel *n*; and, consequently, with the wheels *a*, *a*, connected thereto, the endless floors or bands will be made to revolve simultaneously. Thus, by the connexion of the sliding pinion *g*, the carriage supporting the steam-engine and other machinery is, when required, made locomotive.

At each extremity of the crank shaft *f*, there is a small spur pinion *o*, *o*, in gear with the wheels *p*, *p*, fixed on the counter shaft *q*, *q*. These counter shafts each carry a pair of mitre wheels turning loosely thereon, which take into the teeth of a similar mitre wheel fixed on the end of the axle for each of the drums or barrels *r*, *r*. To these barrels track ropes, bands, or chains, are attached, for the purpose of drawing the ploughs, or other implements, to and fro between the principal and auxiliary carriages.

A clutch box *s*, slides upon each of the counter shafts between the mitre wheels; and when either of the barrels are to be put into operation, the clutch box must be slidden so as to lock it into one of the mitre wheels, which causes the barrel, by its rotation, to wind or coil the extended rope or chain, and draw the plough, or other imple-

ments attached thereto, over the ground. Of course it will be seen that the rotation of the barrels may be reversed by sliding the clutches into the opposite mitre wheels.

In order to work the ploughs or other implements, I first place the auxiliary carriages at convenient distances from the principal or locomotive carriage, and parallel therewith, as shown in fig. 8, and then make fast one end of a rope, band, or chain, to each of the barrels *r*, *r*, on the locomotive carriage. I then coil thereon a quantity of the rope, band, or chain, sufficient, when uncoiled, to extend from the principal to the auxiliary carriages. I then stretch out a continuation of such ropes, bands, or chains, to, and pass them round the pulleys or drums *t*, on the auxiliary carriages, bringing the ends back to the main carriage, and there make them fast to the barrels *r*, in such a way that when the barrels revolve, the rope, band, or chain, may travel round the pulleys of the auxiliary carriages, one end of the ropes, bands, or chains, coiling on the barrels *r*, whilst the other ends are uncoiling therefrom.

To these track ropes, bands, or chains, I attach ploughs, or other agricultural implements, and then (the steam-engine being at work) I throw the barrels *r*, into gear by means of the clutch boxes *s*, *s*, which will cause the ropes, bands, or chains, to travel over the spaces of ground between the main carriage, and the auxiliary carriages drawing the ploughs or other implements through or over the ground in the line or space comprised between the principal and auxiliary carriages.

When the plough or other implement shall have been drawn out to the required distance, it may be turned round by an attendant at the auxiliary carriage, and the barrel *r*, be made to revolve in an opposite direction, so as to cause the plough or other implement to be drawn back again towards the principal carriage.

It is evident that the train of wheels and pinions may be so arranged as to cause the carriage to be advanced or retrograded through a space equal to the width of the land operated upon, and completed by the plough, roller, harrow, or other implement, during the time occupied in the passage of such implement between the principal and auxiliary carriages. Or the principal carriage may rest, during the time of performing such operations, and be put in motion at required intervals, by throwing the pinion *g*, on the crank shaft *f*, into and out of gear, with suitable trains of wheels.

The auxiliary carriages must be advanced or retrograded at rates corresponding with the progress of the principal carriage, whether the latter be moved continuously or at intervals: this may be effected through the pinion *u*, shown in the plan or horizontal view, fig. 6, which pinion takes into the teeth of a wheel *v*, on the axle bearing the broad rollers or drums *w*, *w*; and, by turning the axle of the pinion by a hand spike *x*, the carriage will be moved.

Another obvious mode of communicating motion, and one capable of giving various speeds to the auxiliary carriage, is the employment of a train of wheels and pinions, actuated by winches, gearing into the spur wheel on the shafts, bearing the two drums or rollers. The auxiliary carriages must be sufficiently heavy to resist the drag or force exerted upon the cord, when the plough or other implement is drawn from the principal carriage towards it. In cases when a very great power may require to be exerted, the auxiliary carriage must be weighted accordingly; or it may occasionally be made fast to stakes fixed at proper distances in the soil by a cord or chain, so as to oppose the greatest resistance to the pull of the track rope: in other cases, where operations may have to be performed at considerable intervals or distances, the one from the other, and draining ploughs or other implements requiring great force may have to be used, the pulley, round which the cord passes from the principal carriage, may be attached to stakes or posts driven in the soil at proper distances, or a portable crane may be employed for this purpose.

I do not claim as any part of my invention, the particular construction of the steam-engine delineated. I have adopted it, as well suited for impelling the carriage, and for accomplishing the various objects of my invention; but other forms of engines, as well as other agents than steam, may be applicable as a motive force.

Upon mosses or bog lands, where coal or other fuel may be too expensive, or too difficult to obtain, I propose to use peat to work the engine; in which case, it will be necessary to make the furnace or fire-box of the boiler sufficiently capacious, for containing such a quantity of this bulky kind of fuel as will produce the requisite abundance and force of steam; and as, in such situation, water is at most times procurable from the drains, I propose to supply the boiler either directly from the drains, or from holes formed at convenient distances, by attaching a hose to the pipe of the pump.

I do not intend to confine myself to the precise material or construction, arrangement or dimensions, of the parts of the

principal carriage, or auxiliary carriage or carriages, or to the distances at which such carriages are placed asunder, as shown in these drawings; nor to the manner in which the engine is combined with them. I propose, in some cases, to make use of a carriage having only one endless flexible floor, rail-road, or way; and to place the engine on such carriage, instead of placing it between two endless flexible floors, as hereinbefore described; in which case, it will be necessary to pass the chimney in a horizontal direction, in order to clear the edge of the upper part of the endless flexible floor, whence it may be raised vertically to the required height.

I propose also to employ a modification of the carriage mounted on broad rollers or drums, and impelled by a steam or other engine, and serving as a heavy rolling machine, in order to consolidate the soil, or to break down lumps or clods.

I sometimes employ a carriage mounted on three broad rollers or drums, furnished with a steam-engine of small dimensions and compact form, as represented in figs. 9, and 10. The power is to be communicated by suitable gearing to the two drums, and the machine may be directed into a new path, and be made to travel over fresh ground, after having reached the end of an enclosure or field, by turning the axis of the single drum at an angle to the axis of the two rollers or drums, by means of a rack and pinion acting on the bearing of one end of the axis, the other end being mounted in an adjustable bearing, as shown at fig. 10. The motion of the engine must then be reversed, and one of the two rollers or drums be disengaged from the engine, and allowed to turn freely upon its axis; while the other is locked into the gearing of the engine, and turned round by it. In this manner the machine may be made to take up fresh ground, without being turned completely round. This machine may also be employed to drag ploughs or other agricultural implements, in connexion with auxiliary carriages, by adapting to it barrels fixed and worked in a manner similar to those already described: for this purpose, it may be necessary to apply a wheel in each side of the single roller, in order to give sufficient stability to the carriage. These wheels are shown, dotted in fig. 10, as also the barrels. The wheels are mounted upon temporary axles bolted to the framing, so as to be removed at pleasure.

The wheels, *a*, *a*, *a*, of the principal carriage, are represented as formed of wooden spokes and fellies, with naves of cast iron; but I propose to make them stronger, in cases where the weight of the carriage and engines may require it, by filling in between the spokes with wood, so as to form complete discs; or it may be still more advantageous to employ wheels of cast or wrought iron.

In case the wheels should have a tendency to slip round within the endless floor without carrying it with them, then the two inner straps of iron *e*, *e*, may be made with teeth or cogs fastened upon them at proper intervals, which shall take into the spaces of the wheels *m*, *n*.

I have now described my new or improved methods of draining or cultivating land, and have shown the manner in which the machinery and apparatus are to be applied to the culture of various soils. I have before stated this invention to be especially serviceable on lands which cannot be so conveniently worked and tilled in the ordinary manner by the agency of horses and other cattle. The cultivation of bogs or mosses, require more numerous drains than drier and firmer ground; and, when horses or other cattle are employed, it is necessary that most of the drains should be covered, in order to enable the horses or other cattle to pass over them; but by the system of cultivation by traction obtained from motive power, combined with the arrangement of the principal and auxiliary carriages hereinbefore explained, I am enabled not only to drain, plough, roll, and work the soil by suitable implements, without its being poached or injured by the feet of horses or other cattle; and also to leave the drains open, by which they may be cleansed and deepened, as the water shall subside and the land consolidate.

If, in the progress of these soils, boggy grounds become consolidated, all the original drains, which I propose to make very numerous, should no longer be necessary, a portion of them may be filled up; and of the remainder, such may be left open, and such covered, as circumstances of cultivation may require.

As regards the utility of this invention in a national point of view, I anticipate also that several advantages will result from the substitution of steam power for horses and other cattle, and from the use of peat as fuel for the steam-engines to be employed in the culture of mosses or bog lands: amongst the advantages, will be the abundant and profitable engagement of an unemployed population in the raising and preparing of peat for feeding the steam-engines, and as labourers in reclaiming and cultivating lands which are at present utterly unproductive; and further, that the produce of the soil will be available as food for human beings, instead of being consumed

by horses and other cattle employed in the cultivation.

It will be obvious, as the principal carriage hereinbefore described is capable of locomotion, and contains a steam or other engine of power, that it may be placed in convenient situations, where the power of such engines may be advantageously used for the working of corn mills, thrashing machines, chaff cutters, pumps, or other machinery.—[*Inrolled in the Rolls Chapel Office, November*, 1833.*]

Specification drawn by Messrs. Newton and Berry.

"During the Whitsuntide recess of Parliament, a numerous assemblage of gentlemen from different parts of the country attended to witness an exhibition of this novel and interesting invention; amongst whom were Mr. M. L. Chapman, M. P., Mr. T. Chapman, Mr. H. Handley, M. P., Mr. J. Featherstone, of Griffinstown-house, Westmeath (an enterprising and successful bog-reclaimer), Mr. F. Brown, of Welbourn, Lincolnshire, Mr. James Smith, of Deanston, near Stirling (well known to the mechanical world by his ingenious inventions, applied both to agriculture and manufactures), Mr. B. Hick, and Mr. P. Rothwell, engineers, with other experienced judges of mechanical contrivances. These gentlemen were unanimous in pronouncing the invention to be the germ of great improvements in the science and practice of agriculture, as well as eminently fitted for the particular purpose to which it has, in the first instance, been applied. Two ploughs of different construction were put in action, to the admiration of the spectators; particularly the one last invented, which is double-acting, or made with two shares in the same plane, so that it returns at the end of a 'bout,' taking a new furrow, without loss of time. The perfect mechanism of this plough—the action of the working coulters and under-cutting knives, which divide every opposing fibre of the moss—the breadth and depth of the furrow turned over—the application of a new and admirable means of traction, instead of chains or ropes—together with the facility with which the machine is managed, and the power applied to the plough, especially interested and surprised all present. The speed at which the plough travelled was two miles and a half per hour, turning furrows eighteen inches broad by nine inches in depth, and completely reversing the surface. Each furrow of two hundred and twenty yards in length was performed in somewhat less than three minutes; so that in a working day of twelve hours this single machine would, with two ploughs, turn over ten acres of bog land.

The machine which bears the steam-engines is itself locomotive; but as the ploughs are moved at right angles to its line of progress, not dragged after it, the machine has to advance only the width of a furrow, viz. eighteen inches, whilst the ploughs have travelled a quarter of a mile; in other words, the machine has to be moved only eleven yards in the time that the ploughs have travelled five and a half miles, and turned over a statute acre of land. This is, in truth, the prime distinguishing feature of the invention; it is the contrivance on which the genius of its author is more particularly stamped, and which seems to be essential to the economical application of steam to husbandry; for it is evident, that were it requisite to impel the machine with a velocity equal to that of the ploughs, by dragging them with it, a great proportion of the engines would be uselessly expended.

Another valuable property appertaining to the machine, and which conduces greatly to its economy as a bog cultivator, is, that it requires no previous outlay in the formation of roads, no preparation of any kind, further than a drain on each side of it. That a locomotive machine of such great dimensions and power could be so constructed as to travel on mere raw bog, was an excellence the more appreciated, as it was unexpected, by those persons who are conversant with the soft, unstable nature of bog. The Irish gentlemen present also pronounced Red Moss to be a fair specimen of the great mass of the flat, red, fibrous bogs of Ireland, and that neither the machine nor the ploughs would have any difficulties to encounter in that country, which had not been already overcome on Red Moss, the field of experiment. The engines are capable of working up to fifty horses power; but the operations subsequent to ploughing will require a small force compared with that necessary for breaking up the surface of the bogs, to the depth and at the speed effected by these ploughs. The power consumed by each plough is estimated at about twelve horses; and the weight of the sod operated upon by the plough, from point to heel, is not less than three hundred pounds. The boiler is of unusually large dimensions for locomotive engines, being suited to the use of peat as fuel, so that the culture of a bog will be effected by the produce of its drains. At Red Moss, however, coals are so cheap, being found contiguous to and even under it,

* In this instance, eighteen months have been allowed for inrolling the specification.

that they are used in preference to turf. Eight men are required for the management of the machine and the two ploughs, or at the rate of nearly one man per acre; but it must be understood that this number of men will only be required for the first heavy process, and has no relation to any subsequent operations in the cultivation of bogs, nor to the application of the invention to the culture of hard lands.

After passing a sufficient time on the Moss to witness the exhibition of the ploughs, and the various other functions and properties of the machine, the party expressed to Mr. Heathcoat the extreme pleasure they had received, and their earnest hope that he would extend the sphere of his exertions by applying the invention to the culture of stiff clay soils; and more especially, to carry into effect those important operations of sub-soil ploughing and improved drainage recently introduced to the agricultural world by Mr. Smith, of Deanston. To effect these processes great power is essential; and it was evident that Mr. Heathcoat's invention was equally well adapted to them, and would be attended with results no less important than those which will arise from its application to the reclamation and culture of bogs."—*London Journal.*

TO JOHN ERICSSON, OF THE NEW-ROAD, IN THE COUNTY OF MIDDLESEX, ENGINEER, FOR HIS IMPROVED ENGINE FOR COMMUNICATING POWER FOR MECHANICAL PURPOSES.

Sealed 24th July, 1830.

This invention is a steam wheel or rotary steam-engine: it consists of a tight circular box or chamber, within which another hollow circular box is intended to revolve. The outer box or chamber is made stationary, by being mounted upon a frame or standard. The inner box, called a fly drum, is fixed upon a revolving axle which extends through the former, its ends bearing upon anti-friction rollers. Three radial wings or partitions, as steam stops, are introduced within the rotary drum; but they are independent of it, being affixed to, and made stationary with, the outer box.

Plate 5, fig. 11, represents a sectional elevation taken through the machine in the direction of its axis; *a*, *a*, *a*, is the box or outer chamber, into which steam is admitted by the pipe *b*. The box or chamber *a*, is made stationary, being fixed upon a base with end frame and standard. Through this chamber a shaft or axle *c*, is passed, bearing upon anti-friction rollers at its ends; and to this shaft *c*, the inner box, called the fly drum *d*, *d*, is attached by flanges. Three radial partitions or wings *e*, *e*, *e*, shown in fig. 12, are fixed upon a boss or collar *f*, and made stationary, by the collar being attached to the outer box, and the axle passing through it. The fly drum encloses these wings, but is enabled to revolve freely round them.

Steam being introduced into the external box *a*, it passes through slots or openings into the fly drum, and from thence escapes by an aperture near the axle into the exit chamber and eduction pipe *g*, *g*.

It is intended that the steam, when in the inner box, shall press against the stationary partitions or wings *e*, *e*, *e*, and also against inclined planes on the sides of the openings or induction apertures, by the force and resistance against which the fly drum is intended to be made to revolve, and, by the rotation of its shaft or axle, to communicate a power capable of driving other machinery.

The Patentee observes, "It will be seen that the wings *e*, *e*, must have notches or spaces cut in them, to allow the channels to pass by them in the course of the revolution of the fly drum. With reference to these channels, it is absolutely necessary to observe, that they must be so constructed, that the length of the channel shall always exceed its depth, in such proportion that the channel itself shall always move at a greater speed than the steam acting against its bottom; for when the length is to the depth as two for one, the motion of the acting steam toward the bottom of the channel, will only be one-half as rapid as the motion of the channel itself."

It is unnecessary for us further to recite the Patentee's details and comments upon this invention, as it must be perfectly obvious in what way he proposes to obtain a moving power. We cannot, however, help remarking, that any means of packing the edges of the working parts (which constitutes the most difficult feature in all rotary steam-engines) is not once mentioned in this specification; and, upon the whole, the scheme is of so crude a character, that even its practicability (not to say any thing of its usefulness) appears extremely equivocal. —*Inrolled in the Petty Bag Office, January*, 1831.—*Ibidem.*

DR. CHURCH'S STEAM-COACH.

We have much pleasure in stating that Dr. Church has at length completely and satisfactorily accomplished the construction of a steam-carriage, in every way suited to run on ordinary roads.

PLATE 5

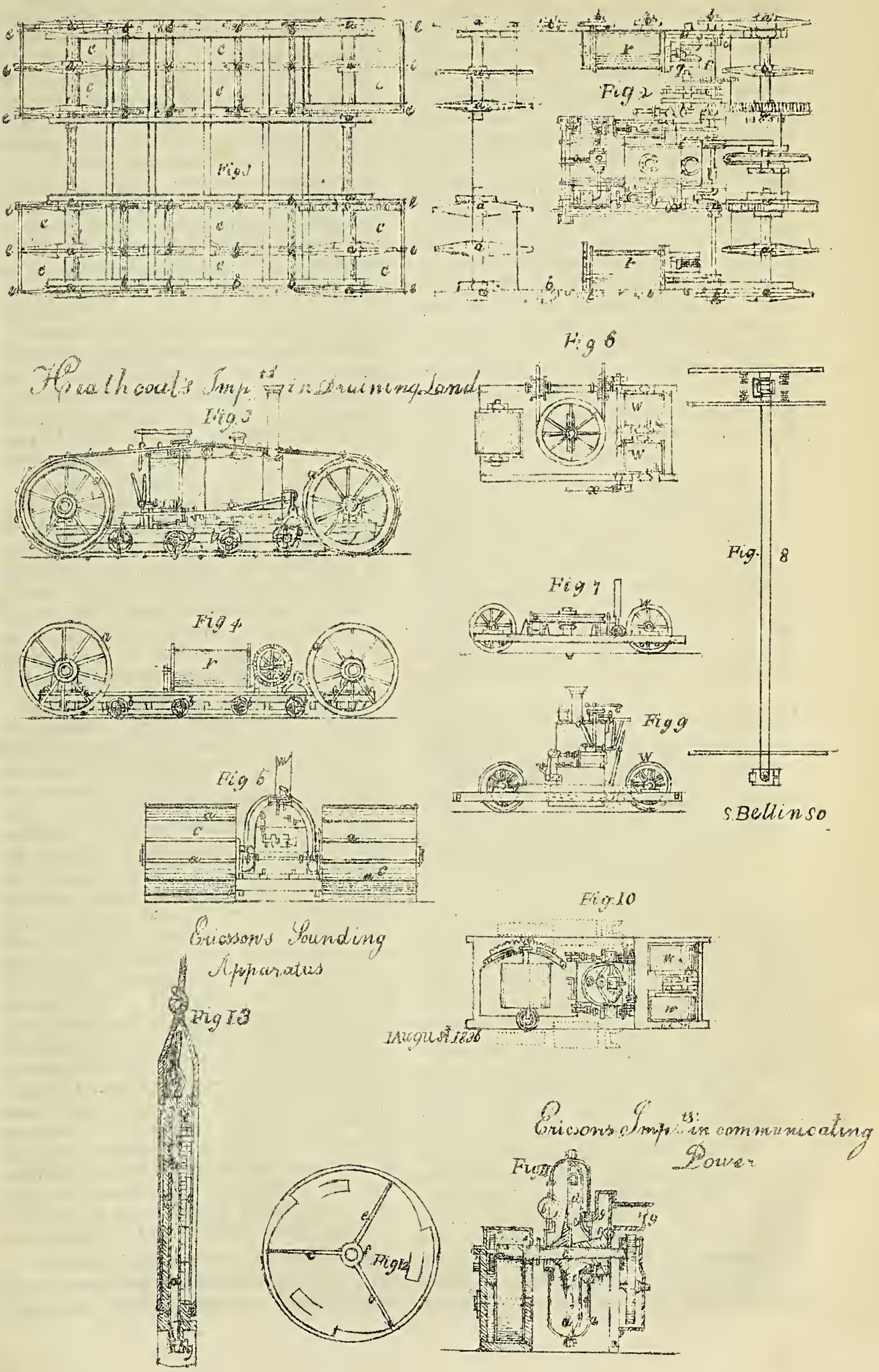
Fig 1
Fig 2
Heathcoat's Impts in Draining Land
Fig 3
Fig 4
Fig 5
Fig 6
Fig 7
Fig 8
Fig 9
S.Bellinso
Fig 10
Ericsson's Sounding Apparatus
Fig 13
1 August 1836
Ericsson's Impts in communicating Power
Fig 11
Fig 12

The external appearance of the carriage is made exactly to resemble a stage-coach, and is about the same dimensions. It consists of a frame-work with a casing enclosing the boiler and engines; the furnace, fuel-box, water-chamber, and condenser, all of which hang upon springs, supported by the running wheels, require no auxiliary tender.

The casing is formed and painted like an ordinary stage-coach, the conductor sits for the purpose of steering in the place of a coachman on the box in front; the engineer who attends the fire and the machinery, and has command of the steam, stands also in front, in an open compartment, below the conductor.

There are seats for persons on the roof before and behind, as in other stage-coaches; but as this carriage is intended merely to be the locomotive engine for impelling a train of carriages connected to it, the seats upon this are to be considered as of an inferior class.

Some of the most important features of the locomotive carriage as now completed, viz. the peculiar construction of the boiler and arrangement of the working parts of the machinery, form portions of the subject of a patent granted to Dr. Church, on the 16th March, 1835; the specifications of which, embracing other matters, is too elaborate for insertion in our present number, but will most probably appear in our next.

As several partially successful, but, in our opinion, very unsatisfactory attempts have been made by other persons, to impel carriages on ordinary roads by steam-power, we consider it necessary to point out some of the peculiarities in Dr. Church's present carriage, which we consider to be its striking features of advantage.—Firstly, though the engines work at high-pressure, the eduction steam is so effectually condensed after passing from the working cylinder, that no visible portion of it escapes into the air, but the whole is converted into water, and re-conducted into the boiler in a heated state. Secondly, the flues are so constructed and arranged, that no smoke is allowed to escape from the chimney; and the consequences of these two novel features, as regards locomotive engines running on ordinary roads, are very important, viz. that neither is there any perceptible noise arising from the discharge of steam, or any offensive effluvia emitted from the combustion, so that the carriage proceeds along the road without, in the slightest degree, attracting the attention of horses which may pass it.

We have only space to say further, that the Birmingham and London Steam-carriage Company, with whom the Doctor is connected in this invention, are perfectly satisfied with the carriage as now completed; and though alterations and slight improvements may and will necessarily be adopted in the future exercise of the plans, yet they deem the present carriage to be so fully effective and satisfactory, that they have advertised for a practical engineer to superintend the erection of a sufficient number of these carriages at their works, exactly according with the model produced.

We understand it to be the intention of the company to establish three stations between London and Birmingham for their trains of carriages to halt at, and to supply a fresh locomotive engine at each station, in order that the engines, after running about twenty-six miles, may be severally examined, and such little matters as cleaning, oiling, and adjusting parts attended to: which arrangement will avoid subjecting passengers to the inconvenience of delay, and tend greatly to prevent accidents.

We have only to add, that having witnessed the manner in which this carriage performs its duty on the public road, we have no hesitation in saying that we are now satisfied steam may be safely, and, we believe, economically employed, in connection with Dr. Church's improved machinery, as an effective substitute for horses, in the ordinary transit of stage-coach passengers on all the turnpike roads in the kingdom.—*Ibid.*

TO JOHN ERICSSON, OF ALBANY-STREET, REGENT'S-PARK, IN THE COUNTY OF MIDDLESEX, CIVIL ENGINEER, FOR HIS INVENTION OF AN INSTRUMENT FOR ASCERTAINING THE DEPTH OF WATER IN SEAS AND RIVERS.

Sealed 14th November, 1835.

The invention now before us, is what is commonly called a sea-gage, and one in which the principal difficulties that these gages are subject to are entirely removed. Some of these difficulties are, firstly, the establishment of a correct register, to point out the depth to which the sounding instrument has gone; little liable to be disarranged by accident, and which will not return to its former position when the pressure of the water is taken away. Another, is the graduation of the scales, as the degrees must diminish very rapidly when the instrument is at a considerable depth; and finally, the preservation of the instrument entire, whilst it is subjected to the enormous pressure of the water at a considerable depth, and which always proves so destructive to hollow instruments. The Patentee

has, in a very ingenious and simple manner, effectually guarded against all these difficulties.

The invention is shown at fig. 3, Plate 5, which represents a vertical section of the instrument, consisting of a glass tube *a*, open at both ends, and firmly fastened, by means of cement, in the cast iron tube *b*: *c*, is the graduated scale of fathoms; *d*, is an air chamber communicating with the external atmosphere by the short pipe *e*; *f*, is a crooked pipe, fastened on to the top of the glass tube *a*, and communicating with it.

When the instrument is to be brought into operation, the stop cock *g*, at the lower end of the glass tube, is closed, so as to stop up the end of the tube, and prevent the escape of the water. As the instrument goes down, the water presses upon the air in the short tube *e*, and compresses the air in the chamber *d*; and as the air is compressed, the water rises in the chamber, and when it reaches the top of the bent tube *f*, it will run down into the glass tube *a*, and in this manner register the number of fathoms to which the instrument has gone. The use of the bent tube *f*, is to prevent the water, when it has once got into the glass tube, from returning into the air chamber *d*, except it is literally turned bottom upwards, which it is not very likely to be, though it may, by the current, be turned on one side. It will be evident, that the pressure of the water cannot have any destructive effect upon the instrument, as it is subject to the pressure of the air and water inside, and by that means the exterior pressure is neutralised. When the instrument is drawn up, the depth is ascertained by referring to the height of the water in the glass tube; the water is then let out of the glass tube by means of the stop cock *g*, and the instrument is again ready for use.—[*Inrolled in the Inrolment Office, May,* 1836.] —*Ibid.*

HEBERT'S FLOUR-MAKER.

(*See Plate* VI, *Figure* 1.)

We fulfil our engagement made in a former Number (665), of giving a description of the larger kind of "Hebert's Patent Flour-makers;" and we adopt for this purpose, the machine which we stated was in successful operation at the workhouse of All Saints, near Hertford, in preference to another machine on the same principle, which the patentee assures us is greatly improved—because, in the first place, we fulfil our promise to the letter; and, in the second place, because the practical demonstration of actual advantages has more weight with us than any deductions from theory, however plausible. And until the inventor shall have given to us equal proofs to those which we are about to submit to our readers of the success of his more recent improvements, we shall rest satisfied with what is before us.

We live in an age when improvements are occurrences of every day, yet it is singular that the process of grinding and dressing wheat is nearly the same as it has been for centuries. The French burr stones, awkward, massive, and troublesome, have hitherto been free from the inventive assaults of enterprise and genius; and when we reflect how long the miller has been wedded to his upper and nether millstone, we can hardly expect this invention to attract his attention, but we think it a subject worthy of consideration to those who are friendly to manual labour, either as employment or punishment, to inquire how far a cheap process can be introduced in the manufacture of an article of the first consumption; and should it appear that England possesses within herself the means of effectually superseding the French burr stones, the greater honour will rest on those who are the means of its introduction.

The engraving (*Pl.* vi, *fig.* 1,) exhibits a perspective sketch of the flour-maker constructed by Mr. Hebert, for the workhouse at All Saints, where it has been constantly at work, without the slightest deterioration of the grinding surfaces, for a period of time, that would, in ordinary mills, have required a renewal of them many times. For the purpose of ascertaining the efficacy of this new machine, the following questions were addressed to the Guardians of the Union and the Master, to which the former replied in general terms that they were "satisfied with the working of the machine," while the latter answrede each question categorically in the words which we subjoin.

1. How *few* men are competent to work the machine, so as properly to grind and dress? —One.

2. How *many* men can you efficiently employ in working the same?—Fourteen.

3. Can you employ *boys* equally as well as men?—Yes.

4. What is the opinion of the millers at Hertford of the quality of the flour produced?—Their opinion is, that the quality of the flour is good.

5. Do you find that the number of persons at work makes any difference in the quality of the flour or other products; or does that circumstance affect only the *quantity* of work done?—It makes no difference in the *quality*, but only affects the quantity.

6. Do you find any difficulty in making the necessary adjustments, especially as relates to the means of proportioning the work according to the number of labourers employed? —No difficulty.

7. Do you find the superintendence and management of the machine absorb much of your time?—No.

8. Has your experience in the working of the new "Patent Flour-maker" convinced

you that the presumed difficulty of grinding and dressing simultaneously is in this new machine completely obviated?—Yes.

9. Do you consider that the skill and superintendence of a regular miller is in this new machine at all necessary?—No.

10. Do you consider that the machine works as perfectly now as when first erected?—Yes.

The answer to the 9th question appears to us to be one of considerable importance, as relates to the economical working of the machine, especially in a workhouse; for in all other mills that we are informed of, the expense of a professed miller to superintend their operations is entailed upon the establishment. This is, indeed, unavoidable with the ordinary stone-mills, as their surfaces require frequent dressing or re-cutting, at least once a week when constantly in use. Besides the stoppage or loss thus occasioned of one day in every week, it requires great practical skill (at necessarily high wages) to execute such work in an efficient manner. The wear and tear of tools and machinery is also considerable; the repairs amounting in the mill worked at Giltspur-street Compter to 20*l.* a year, and this is in addition to a miller and two assistants.

It has heretofore been deemed impracticable to grind and dress simultaneously; but we have been informed, that all the millers who have seen Mr. Hebert's machine have entirely changed their opinions in this respect, the flour produced by it being unexceptionably good; and it is perhaps worthy of remark, that, owing to the grinders being entirely metallic, there is no possibility of having gritty flour from them, which is sometimes excessively unpleasant in bread made from flour produced by the ordinary mill-stones. It appears, however, from the specification of the patent, that the invention does not consist in the *material* of which the machine is formed, but lies in the mechanical arrangements, which are defined to be these, if we recollect rightly:—The grinding and dressing of wheat, or the reduction and separation of other substances, by means of a single machine, in which the grinding and dressing operations are conducted upon one continuous surface; or wherein the meal, as it is projected from the circumference of the grinders, is received into a sieve whereon it is dressed. The patentee seems to give the preference to metallic surfaces on the ground of his having made great improvements therein, especially as relates to the easy means afforded of giving the grinding surface an unusual degree of truth; and that kind of roughness which so nearly approximates to the French burrstone, as he expects will lead to the entire abandonment of the latter. An example of the application of burr-stones to these patent "flour-makers" is, however, given in the specification, as the invention equally embraces them.

It has long been anxiously desired by philanthropic legislators, that a substitute might be found for the horrid and degrading punishment of the lash. Now, we are strongly impressed with the idea, that a machine of this kind, but of the size described in our previous Number (665), is admirably adapted to effect the object in view, as the offender might thereby be easily made to atone in confinement for his offence, by grinding a given quantity of corn, as the condition of his liberation—say, for instance, a bushel for getting drunk, a sack for insubordination, and so forth.—*Mechanic's Magazine.*

AERONAUTIC OBSERVATIONS.

Since Mr. Green's first attempt at ballooning he has travelled through the air above 5000 miles, having made 218 ascents, and has had a bird's-eye view of every part of England. On the last occasion, when Lord Clanricarde went with him, he observed that surveyors and architects could with greater facility take plans of noblemen's estates by ascending in a balloon, as they could have a bird's-eye view of every locality, and if they only once adopted that method they would never relinquish it. Since the suggestion an artist named Burton called on Mr. Green to obtain him the plan of a balloon constructed so as to act in the above way, it being connected to the car by a swivel. The inventor proposes to build a waggon, for the purpose of fastening a balloon to it, which, when filled with gas, which can be done in various parts of the country at gas company's gasometers, may be conveyed to any place a surveyor requires, where, on a calm day, he can take plans, carrying with him the proper instruments. The balloon will then be fastened by ropes to the spot most favourable for observation, and raised to an elevation of 300 or 400 feet, as necessary. In this way a bird's-eye view can be taken of any town or city. Mr. Green is willing at any time that his balloon, by way of experiment, may be made use of in that way.—*Globe.*

NEW LOCOMOTIVE-POWER.

Mr. Mullins, M. P. for Kerry, has made a very important discovery in the scientific world, that of applying galvanism, instead of steam, for propelling vessels and carriages. He is now building a carriage upon his principle, and several of the first engineers, who have seen it, say there is every prospect of success, and that it will supersede steam.—*Limerick Star.* The *Dublin Evening Post* claims the merit of this invention for the Rev. J. W. M'Gauley, who, it will be remembered, brought forward something of this kind at the meeting of the British Association of Science in Dublin last August.—*Mech. Mag.*

CONSUMPTION OF OPIUM IN CHINA.

"It is a curious circumstance," says the *Quarterly Review*, "that we grow the poppy in our Indian territories to poison the people of China, in return for a wholesome beverage which they prepare, almost exclusively, for

us." From the following statement made by Mr. Davis, late Chief Superintendent at Canton, it appears that the money laid out by the Chinese on their favourite drug far exceeds what they receive for their tea :—

Imports in 1833.

	Dollars.
Opium....................	11,618,167
Other Imports....	11,858,077
	23,476,244

Exports in 1833.

	Dollars.
Tea...............	9,133,749
Other exports......	11,309,521
	20,443,270

The Chinese smuggle all this opium, and pay the difference between the price of it and that of the tea they export in silver.—*Ibid.*

TELEGRAPH.

A new telegraphic system, applicable to nautical purposes, invented by M. Claude Sala, has just been presented as laying claim to the Monthyon prize. It is described as remarkable for its simplicity; for, by the aid of eight signs, it produces, without difficulty, all the words of the vocabulary, and, by means of two lanterns, it can carry on a nightly correspondence.—*Athenæum.*

ARSENIC.

M. Schweiger Seidel has invented a very simple method of ascertaining the presence of arsenic in food, &c. however small the quantity may be. He puts a portion of the matter to be tried, and double its weight of soda, into a little glass tube; he closes the open extremity of the tube with blotting paper, and heats the other end with a taper: the arsenic is sublimated in a few moments, and adheres to the sides of the tube in the part which is not heated.—*Ibid.*

SPONTANEOUS COMBUSTION.

An instance of spontaneous combustion is reported in the French paper, to have taken place at Aunay, in the department of Avalon. A very fat woman, aged 74 years, and addicted to drinking brandy at 27 degrees, lived alone, and one evening returned home as usual, but, as she did not appear among her neighbours the next morning, they knocked at her door. No answer being returned to repeated demands, they summoned the mayor, who forced the door, and exposed a horrible spectacle, accompanied by an extraordinary smell. Near the chimney laid a heap of something burnt to cinders, at one end of whichwas a head, a neck, the upper part of a body, and one arm. At the other end were some of the lower parts, and one leg, still retaining a very clean shoe and stocking. No other traces of fire were to be seen, except a blue flame which played along the surface of a long train of grease, or serous liquor, which had been produced by the combustion of the body. The mayor found it impossible to extinguish this flame, and summoned all the authorities; and, from the state of the apartment and comparison of circumstances, it was concluded among them, that, previous to going to bed, for which she had evidently been making preparations, the woman had been trying to ignite some embers with her breath. The fire communicating with the body by means of the breath, combustion probably took place, and would appear to confirm an opinion enterained by several learned men, that that which is called spontaneous combustion of the human frame never takes place without the presence of some ignited body near the person predisposed to combustion. A surgeon, who bled an habitually drunken person, accidentally put the blood extracted near a candle, when immediately a blue flame appeared on the surface, which he found extremely difficult to extinguish.—*Mech. Mag.*

M. BIOT.

The learned and scientific M. Biot has been delivering some very remarkable lectures at the College de France. He has proved, that, by means of polarised rays, it is possible to ascertain the chemical action which takes place between bodies held in solution, in various liquids; an action which has not yet been discovered by less delicate means. This is a new branch of science, created as it were by this great natural philosopher, from which the most important and curious results may be expected.—*Ibid.*

CORN AND COTTON-PLANTING MACHINE.

A free man of colour, Henry Blair by name, has invented a machine called the corn-planter, which is now exhibiting in the capital of Washington. It is described as a very simple and ingenious machine, which, as moved by a horse, opens the furrow, drops (at proper intervals, and in an exact and suitable quantity,) the corn, covers it, and levels the earth, so as, in fact, to plant the corn as rapidly as a horse can draw a plough over the ground. The inventor thinks it will save the labour of eight men. He is about to make some alterations in it to adapt it to the planting of cotton.—*New York Paper.*

DR. ARNOTT'S NEW STOVES.

At a meeting of the Philosophical Society of Edinburgh, which took place lately, one of Dr. Arnott's new stoves was exhibited. It is an oblong box, about three feet long, two broad, and two deep, carefully made air-tight on every side. A partition within divides it into two parts, apertures above and below enabling them to communicate with each other. An aperture is arranged for the free admission of air, and another for carrying off the smoke; an air-tight door admits fuel.

A stove made of earthenware, and placed on one side of the partition, contains all the fuel required, and the hot air circulates round and round the partition before it is eventually carried off by the small tubular chimney. An extensive surface of 32 square feet is thus presented to the air at a moderate elevation of temperature, about 212 ; and, accordingly, scarcely any thing passes up the chimney which has not been almost entirely exhausted of its heat. This stove saves equally time, trouble, and fuel, and is quite free from the dust of a common fire.

DR. REID'S SYSTEM OF VENTILATION.

At the conclusion of the same meeting, the Society adjourned to a new apartment, constructed by Dr. Reid, illustrative of his arrangements for ventilation, &c. It is 32 feet long, and 18 broad, the floor being pierced with 50,000 apertures for the admission of air. A series of experiments have since been commenced in it, in one of which, intended to show the working of the flues, 100 individuals remained in it for upwards of an hour, the room having been alternately filled with warm and cold air, and partially charged with ether and nitrous oxide, at different times. The air was completely renewed by a slow and insensible current every five minutes, and the various changes so gradually induced, that it was impossible to tell when they commenced. The plan is equally applicable to public buildings and private dwelling-houses, as well as to hospitals, churches, public assemblies, and all those places where, from a crowded apartment, the air becomes oppressive both from heat and noxious effluvia.—*Scotsman.*

A NEW THEORY OF THE TIDES,

BY ALEX. CLARK, ESQ. ENGINEER.

For the purpose of literal demonstration, let us suppose that the distance of the earth's centre from the centre of the moon is 240,000 miles, that the diameter of the earth is 8000, and that of the moon 2000 miles, and that they are dense in proportion to their sizes. Then as globes are to each other as the cubes of their diameters, the density of the earth will be sixty-four times that of the moon, and the centre of gravity of both sixty-four times nearer the former than the latter. This point is within the body of the earth, or about 3750 miles from its centre. The moon is said to revolve round the earth, in which saying there seems no impropriety ; but for our purpose it is necessary to state that, strictly speaking, these two bodies revolve on the above point, which is the centre of gravity both combined. The above numbers are not correct, but they are sufficient for our purpose.

The centrifugal force, created by the revolution of the earth in this small orbit round the combined centre of gravity of the earth and moon, will have a constant tendency to make the earth fly off from that centre, which she would do if it were not for the attraction of the moon acting with equal force in a contrary direction. The earth is therefore between two forces, and being partly fluid, the fluid parts are elongated in the direction of these forces. This elongation constitutes the double diurnal lunar tide, which flows in a contrary direction to the diurnal motion of the earth on its axis. Now for the solar tides.

According to the law of universal gravitation, every particle of matter of the terrestrial globe will attract every particle of matter in the lunar globe, and *vice versa.* The attraction between those bodies may be compared to a chain binding them together, every link of which sustains the same strain, for a chain freely suspended between two points cannot have a greater strain at one part than another (barring weight, which in this case it is supposed to be devoid of). The attraction at the moon must therefore be exactly equal to that at the earth, and as the centripetal and centrifugal forces are always equal and contrary, they must produce results on the moon's surface similar to the terrestrial tides, provided that luminary be surrounded with fluids like the earth. Apply this doctrine to the earth as influenced by the sun, and the effect must be a double diurnal solar tide on the earth.

The spring tides are caused by the central forces acting parallel and in unison at the fulls and changes of the moon, and the neap tides by acting at right angles or in opposition to each other at the quarters.

From what I have said it might be supposed we have four diurnal tides, viz. two solar and two lunar ; but this is not the case, the sun's influence being much smaller than that of the moon, perhaps in the proportion of 1 to 5. The solar tide combining with the lunar, becomes evanescent, and will be best shown by figures as follows :— Supposing the lunar tide at any particular place to rise 15 feet, and that at the same place the solar tide rises 3 feet, then when the moon is at the full or change, and her attraction acts in conjunction with the sun's, we shall have $15 + 3 = 18$ feet, or a spring tide ; but when the moon is at the quarters and acts in opposition to the sun, we shall have $15 - 3 = 12$, or a neap tide.—*Mechanic's Magazine.*

THE NEW STEAM-BOAT NOVELTY.

The recent successful experiment of driving this boat, of the largest class, with anthracite coal, against the tide and a strong current from heavy rains, at the rate of 16 miles in the hour, has caused much remark in our city, as an astonishing fact of great importance on the subject of fuel, which may lead to revolutions in steam navigation. Dr. Knott, the distinguished President of Union College, is the well-known proprietor of the Novelty, which he constructed, we believe, with machinery modelled after his own ingenious invention, so as to adapt it ultimately to the same economical principles of combustion which have given such deserved celebrity to his patented stove. The fact of the practicability of using anthracite being now ascertained so as to produce as great a degree of speed as pine-wood, will no longer compel steam-boat proprietors to import their wood at exorbitant prices from the remote forests of Maine and the shores of the Cheasapeake. Nearer by, and almost at our own doors, we have the anthracite coal-mines of Pennsylvania, of every possible variety, in exhaustless quantities. In the trips to Albany for one season the difference in cost between wood and anthracite for the Novelty, it is ascertained, would be 19,000 dollars, in favour of coal. The successful navigation of the Atlantic from America to Europe is made certain. Among the other great advantages would be the vast saving of human life, as it is believed the steady, intense, radiated heat of anthracite will be in some degree a security against those sudden accumulations which arise from the inflammable blaze of pine-wood. There is also an entire freedom from the annoyance of smoke, and the danger of fire from showers of sparks. Wood is now selling at the Hudson at five or six dollars a cord. The cost, in fact, of pine-wood is about double that of anthracite. The passage and freight, therefore, must soon be reduced to half the present rates. The Novelty is remarkable for the ease with which she glides through the water, the motion being without any jarring.—*New York Evening Star.*

HOME-GROWN FLAX.

We understand the agriculture practice of sowing flax in this part of the country, for domestic purposes, is becoming much more general than it was formerly. The returns from Riga and American seed have, in many instances, been very great. The Dutch seed has also been found to answer well; and there is every reason to think, if farmers would direct their attention more to the cultivation of this crop, it would turn out a profitable one, not only for family purposes, but as an article for sale. The importance of flax crops in Ireland may be judged from the fact, that there has lately been brought into the market in Derry as much as 200 tons per week, averaging in value from 40*l.* to 80*l.* per ton; and there has been imported this season, at Belfast alone, above 9000 hogsheads of flax-seed, Riga, America, and Dutch.—*Aberdeen Paper.*

EMBOSSING ON WOOD.

A new and ingenious method of embossing on wood has been invented by Mr. J. Straker. It may be used either by itself, or in aid of carving, and depends on the fact, that if a depression be made by a blunt instrument on the surface of wood, such depressed part will again rise to its original level by subsequent immersion in water. The wood to be ornamented having first been worked to its proposed shape, is in a state to receive the drawing of the pattern; this being put in, a blunt steel tool, or burnisher, or die, is to be applied successively to all those parts of the pattern intended to be in relief, and at the same time is to be driven very cautiously, without breaking the grain of the wood, till the depth of the depression is equal to the subsequent prominence of the figures. The ground is then to be reduced by planing or filing to the level of the depressed part; after which the piece of wood being placed in water, either hot or cold, the parts previously depressed will rise to their former height, and will thus form an embossed pattern, which may be finished by the usual operation of carving.

MAISE SUGAR.

Dr. Ballas having sent two specimens of the maise sugar to the French Academy of Sciences, M. Biot has submitted them to certain effects of polarisation in order to ascertain their precise nature. The deviation of the polarised rays to the right of the place of polarisation in an aqueous solution of this sugar after filtration, and the proportion of its inversion to the left by the addition of liquid sulphuric acid, have been found by M. Biot to agree with the pure sugar derived from the cane.—*Athenæum.*

BENEFICIAL EFFECTS OF RAILWAYS.

Some idea of the employment which railways will find for the labouring classes may be formed from the fact, that at this moment between 10,000 and 11,000 men are employed on the London and Birmingham Railway only.—*Spectator.* Taking this number as data, the average of accidents which occur in the prosecution of the works, is certainly under that which happens to an equal number of workmen engaged in the ordinary occupations of bricklayers, masons, carpenters, labourers, and so forth.

TIME AND TEMPERATURE MEASURER IN ONE.

M. Arago announced at the last sitting of the French Academy of Sciences, that a Danish watchmaker has invented a watch, which at the end of the day indicates the mean temperature of twenty-four hours.

THE

STUDY OF SCIENCE,

A FAMILIAR INTRODUCTION

TO THE

PRINCIPLES OF SCIENCE AND THE ARTS.

THE PRACTICAL MECHANIC.

ANIMAL POWER.

1. The force of men and animals to put machinery in motion and to produce mechanical effects of various kinds, depends so much on a variety of complicated circumstances, that it is very difficult to reduce it to a fixed standard of measure. The circumstances which have the greatest share in determining the amount of this force are, the natural constitution of different individuals of the same species, their acquired dexterity or constant practice, the nature of the performance, or the muscles brought into action, and the duration of the labour or the speed with which it is performed. Few of these points can be made the direct subject of calculation, owing to our total ignorance of the divine mechanism by which the living principle is made to operate on the animal structure.

2. *Definitions.*] The laborious effort which an animal can make for a few instants, is greatly superior to that which he can continue to make for the period of a day's labour. The momentary effort is called the *absolute force*, and the daily effort the *permanent force*. In performing the daily effort there is a certain speed or velocity of action which produces the greatest amount of useful effect; this is called the *maximum effect* of the permanent force. D. Bernouilli considered that the measure of the permanent force of man is nearly a constant quantity, and that it does not vary much either among individuals or in different kinds of labour. Venturoli and others doubt this fact, owing perhaps to the mode in which this force has been estimated; but we think that Bernouilli is right, and that the proposition may be extended to the permanent force of other animals; this force, of course, varying with the species.

The ordinary method of computing mechanical effect or animal power, is by finding the *weight* that can be raised to a certain *height* in a given *time;* then, the *product* of these three quantities is called the *measure* of the labour or force employed in raising the weight, that is, the mechanical effect. Force is also measured by *dynamic units;* thus, a giving measure of water or a given wieght raised through a given space is a *dynamic unit;* so is the power of an animal exerted during a given unit of time. In France, a dynamic unit is the weight of a cubic metre of water raised to the height of a metre, or 2208 lbs. raised 3,281 feet. In England, the most common dynamic unit is a horse's power, which is variously estimated by engineers. There can be no doubt that a practical man must form a more correct idea of the quantity of mechanical power expressed by this dynamic unit than by any other that could be proposed: because the power of the horse is constantly brought under his observation, both in the impulsion of machinery, and in the transportation of loads.

3. *The Dynamometer* is an instrument for measuring the absolute force of men and animals. Dynamometers of various kinds have been invented; those of the simplest construction are the same in principle as the spring steel-yard; others are either modifications of this instrument or a combination of levers with the spring. The Dynamometer of Regnier consists of an elliptic spring which is bent either by pressing it together at the vertices of the minor axis, or drawing it apart at the vertices of the major axis. In both cases, the sides of the spring are made to approach each other and thus to move an index which points to a graduated semicircle, and shows the amount of force which has been applied to bend the spring. The semicircle is doubly graduated; the one scale indicates the force applied at the vertices of the minor axis; the other scale, that applied at the vertices of the major axis. For a further account of similar instruments, see Lardner's Cyclopædia, vol. v. p. 305.

4. *Human Strength.*] The absolute force of *pressure with the hands* was found by the dynamometer of Regnier, to be on an average equivalent to the weight of 110 lbs. The most advantageous and convenient position of the arms in pressing, is that of a line which makes an angle of 45° with the vertical. The right hand commonly presses with more force than the left; and the force of both together is equivalent to the sum of the forces of each taken separately.

The absolute force of man in *lifting a weight with both hands* was found by the

dynamometer to be on an average equivalent to 286 lbs. The best position of the body in this case is the erect, with the shoulders slightly inclined. The greatest average load which a man can support on his shoulders for some instants, is commonly reckoned 330 lbs.; and it is supposed that he can exert the same force in drawing vertically downwards; but these results are not dynamometrically ascertained.

The mean absolute force of man in *drawing or pulling horizontally* was found by the dynamometer to be the same as that exerted in pressure with the hands, or 110 lbs. The force of the horizontal pull in the strongest men was found to be only about 20 lbs. more than the average; while in the other modes of applying force, much greater differences occurred. The reason appears to be, that, in drawing, the force depends more upon the weight of the body than upon muscular force.

5. *Human Labour.*] The permanent force of men and animals cannot be accurately ascertained by the dynamometer; it is only by a series of careful observations on daily labour, that we can arrive at the average useful effect of animal exertion. In order to compare the different estimates of the force of moving powers, Dr. T. Young assumed, as a dynamical unit, the mean effect of the labour of an active man working to the greatest possible advantage: this he considered to be a force capable of raising 10 lbs. 10 feet in a second for 10 hours a day; or, 100 lbs., which is the weight of 10 imperial gallons of water, 1 foot in a second, or 36,000 feet in a day; or, 3,600,000 lbs., or 36,000 imperial gallons, 1 foot in a day: this may be called a force of 1, continued for 36,000 seconds.

M. Schulze, of Berlin, made a series of valuable experiments, in order to determine the accuracy of Euler's empirical formula, or rule expressing the relation between the force and the velocity of animal agents. From experiments on 20 men, of different sizes and constitutions, he found their *mean absolute force*, in lifting weights, to be about 250 lbs.; and in a level pull, about 100 lbs, when standing still, and holding a silken cord passing horizontally over a pulley fixed above a pit, into which weights were suspended at the other end of the cord.

Their mean absolute velocity, that is, when unencumbered by any load, was next ascertained by experiments made on a level plain, where the men marched at a fair pace, without running, for a period of 4 or 5 hours. This velocity was found to be about 5, 1-3 feet per second, or 320feet per minute, or 3, 7-11 miles per hour.

6. *Their mean relative or permanent force* was next determined by comparing their force in turning an upright cylindrical machine, with that of the weight which made it revolve, suspended at one end of the cord above mentioned. This mean force was found to be equivalent to about 30 lbs., moving with a velocity of $2\frac{1}{2}$ feet per second.* From numerous comparisons, Smeaton concluded that the mechanical power of a man is equivalent to 3750 lbs., moving at the velocity of one foot per minute: Mr. Tredgold estimates from this conclusion, that the average mechanical power of a man is $31\frac{1}{4}$ lbs., moving at the velocity of 2 feet per second, when the useful effect is the greatest possible; or half a cubic foot of water raised 2 feet per second—a very convenient expression for hydrodynamical inquiries. This estimate is very nearly the same, therefore, as that derived from M. Schulze's experiments. Mr. Tredgold states, that if a man ascend a ladder vertically, the velocity corresponding to the maximum of useful effect will be one foot per second, and the load double what he carries horizontally; consequently, the average of useful effect is $62\frac{1}{2}$ lbs., or 1 cubic foot of water raised 1 foot per second. Dr. O. Gregory states, that according to the best observations, the mean force of a man at rest is 70 lbs., and the utmost velocity with which he can walk is about 6 feet per second, taken at a medium. He thence deduces 31, 1-9th lbs. as the greatest useful effect which a man can exert when in motion; the velocity being 2 feet per second, or rather less than $1\frac{1}{2}$ miles per hour.†

7. Dr. Gregory demonstrates the following mechanical theorems, and shows their applicability to the mean action of men and animals:—1. The absolute velocity of an animal is to its relative velocity, that is, when impeded by a given resistance, as the square root of its absolute force is to the difference of the square roots of its absolute and relative forces. 2. The work done by an animal is greatest, when the velocity with which it moves is 1-3 of its absolute velocity; or, when its relative force is 4-9 of its absolute force. 3. The greatest useful effect is consequently 4-27 of the product of the absolute force and the absolute velocity.

8. Sir John Leslie,‡ with his usual tact, has simplified Euler's formula, as confirmed by the above experiments, and we may now express it in the words of the following

* Philosophical Magazine vol. xxxix, No. 168.
† Gregory's Mechanics, vol. i. p 349.
‡ Natural Philosophy, p. 281.

rule :—*Given the velocity, or rate per hour, at which a man travels, to find his power or force of traction :—Square the difference between 6 miles and the given velocity in miles, multiply by 2, and the product will be the required force in pounds avoirdupois.* This rule gives the following results :—

Velocities,	0	1	2	3	4	5	6
Forces,	72	50	32	18	8	2	0

From this rule, it appears that the greatest useful effect is produced, when a man walks at the rate of 2 miles an hour, his power of traction being then 32 lbs ; this amounts to a force of 3,379,200 lbs., raised 1 foot per day of 10 hours—an estimate which is only about 1-16 part less than that assumed by Dr. T. Young.

9. In other kinds of human labour, such as climbing stairs, ladders, and mountains, loaded or unloaded; pumping water, sawing wood and stones, driving piles, working at a capstan or windlass, wheeling loaded barrows, digging with a spade, turning a winch, &c., it is almost impossible to establish any proper means of comparison, or to reduce the calculations of the forces employed in each kind of labour to a common or fixed rule. For farther illustration of this subject, therefore, we must refer to the authors already cited, and to such well-known writers as Desaguliers, Emerson, Coulomb, and Hachette. See Gregory's Mechanics, arts, 66—69.

10. *Horse Power.*] The *absolute force* of the horse, in *drawing horizontally*, as ascertained by the dynamometer, is on an average no less than 770 lbs. ; consequently the power of a horse in this kind of momentary exertion, is equal to the force of 7 men. The amount of the *permanent force* of a horse, however, is found to be considerably less than this, varying from that of 6 men to that of 5 men according to different estimates. Dr. O. Gregory reckons the power of a horse equivalent to that of 6 men ; but he states this power as equivalent only to 420 lbs. at a dead pull. Desaguliers, Smeaton, and Leslie, reckon the power of a horse equivalent, on an average, to that of 5 men. Tredgold reckons a horse power equal to that of 6 men, at a medium, and the rate of travelling about the same as, or perhaps rather less than, that of a man, when continued for 8 hours.* On the whole, it appears, when the period of continuance is made an element in the calculation, that the power of a horse, working 8 hours a-day, is, on an average, not more than equivalent to that of five men, working 10 hours a-day.

* Notes to Buchanan on Mill Work, vol. i. p. 167.

11. *Permanent force of a Horse.*] Desaguliers reckons that a horse will walk at the rate of $2\frac{1}{2}$ miles per hour, against a resistance of 200 lbs., that is, at the rate of 220 feet per minute ; a horse's power is therefore equivalent to a force that will raise 44,000 lbs. 1 foot per minute, when working 8 hours per day. Mr. Watt found, from repeated experiments, that a horse treading a mill path at the rate of $2\frac{1}{2}$ miles an hour, will, on an average, raise about 150 lbs. by a cord hanging over a pulley, which is equivalent to raising 33,000 lbs., 1 foot high in a minute. His steam-engines were calculated to work at the rate of 44,000 lbs. per horse power; but he allowed only 33,000 lbs. in his calculations, considering the difference due to loss by friction. Boulton and Watt ultimately estimated the horse power at 32,000 lbs. Tredgold reckons it at 27,500 lbs. when continued 8 hours a-day, and 33,000 lbs. when continued 6 hours a-day. Smeaton estimated a horse power at 22,916 lbs ; this is generally considered too low, otherwise the loss by friction must have been very considerable. It is common in practice, to reckon that it requires one horse's power to drive 100 spindles with preparation of cotton water twist; 1000 spindles with preparation cotton mule yarn; and 75 spindles with preparation flax yarn. See Buchanan on Mill Work, p. 157.

12. Leslie has elegantly simplified Euler's formula, as applied to the power of a horse in drawing ;* and we may now express it also in the words of the following rule :—*Given the velocity or rate per hour at which a horse travels to find his power of traction :—Square the difference between* 12 *miles and the given velocity in miles, the result will be the required power in pounds avoirdupois.* From this rule we obtain the following results :—

Velocities,	0	1	2	3	4	5	6	7	8	9	10	11	12
Forces,	144	121	100	81	64	49	36	25	16	9	4	1	0

Thus it appears that the greatest useful effect is produced when a horse walks at the rate of 4 miles an hour, his power of traction being then 64 lbs. ; this amounts to a force of 22,528 lbs., raised 1 foot high per minute—an estimate which agrees very nearly with that of Smeaton.

13. The power of a horse depending greatly on his speed, formulæ have been given for the calculation of this element, according to its duration. The following rule is derived from Leslie's formula:—*Divide the square of the difference between* 20 *hours and the given duration of a horse's motion in hours by* 25, *and the quotient will be his maximum velocity in miles per*

* Natural Philosophy, p. 283.

hour when unloaded. Hence, we have

Durations, 1 2 3 4 5 6 7 8 9 10
Velocities, $14\frac{1}{2}$ 13 $11\frac{1}{2}$ $10\frac{1}{4}$ 9 $7\frac{7}{8}$ $6\frac{3}{4}$ $5\frac{3}{4}$ $4\frac{7}{8}$ 4.

Tredgold's formula gives the following rule for the same purpose:—*Divide* 14.7 *by the square root of the duration in hours, and the quotient will be the maximum velocity in miles per hour, when unloaded.* Hence, we have

Durations, 1 2 3 4 5 6 7 8 9 10
Velocities, $14\frac{3}{4}$ $10\frac{1}{2}$ $8\frac{1}{2}$ $7\frac{1}{3}$ $6\frac{2}{3}$ 6 $5\frac{1}{2}$ $5\frac{1}{4}$ 5 $4\frac{1}{8}$

These results nearly agree with the former in the extreme cases, but differ considerably in the intermediate cases. Tredgold's formula for the power of a horse's traction, expressed in words, is as follows: —*Divide the difference between the maximum velocity, when unloaded, and the given velocity, when loaded, at the given duration of labour per day, by the said maximum velocity, and multiply the quotient by* 250; *the result will be the horse's power of traction in lbs.* Taking the hours of labour at 6 per day, the utmost that he would recommend, the maximum of useful effect will be 125 lbs., moving at the rate of 3 miles an hour; considering the expense of carriage at this rate as unity, the comparative moving force, and proportional expense at different velocities, will be as follows:—

Velocities, 2 3 $3\frac{1}{2}$ 4 $4\frac{1}{2}$ 5 $5\frac{1}{2}$
Forces, 166 125 104 83 $62\frac{1}{2}$ $41\frac{2}{3}$ $36\frac{1}{2}$
Expense, $1\frac{1}{8}$ 1 $1\frac{1}{8}\frac{3}{4}$ $1\frac{1}{8}$ $1\frac{1}{3}$ $1\frac{1}{8}$ 2

Thus it appears that the expense, which is inversely proportional to the effect, that is, the product of the force and the velocity, is doubled when the speed is increased from 3 to $5\frac{1}{8}$ miles per hour.

14. According to the preceding rules of Tredgold, the greatest useful effect of the horse is $125 \times 3 \times 6 = 2250$ lbs. raised 1 mile per day. In comparing this with fact Mr. Bevan who made many experiments on a horse's power in dragging boats on the Grand Junction canal, found the force of traction to be 80 lbs. and and the space travelled in a day 26 miles; this gives the greatest useful effect equal to $80 \times 26 =$ 2080 lbs. raised 1 mile per day, the rate of travelling being barely $2\frac{1}{2}$ miles per hour.

15. The most useful mode of applying a horse's power is in draught, and the worst is in carrying a load. This is owing to the structure of the animal. It has been found that 3 men carrying each 100 lbs. will ascend a hill with greater rapidity than 1 horse carrying 300 lbs. When a horse has a large draught in a waggon, however, it is found useful to load his back to a certain extent; this prevents him from inclining so much forward as he would otherwise do, and consequently frees him from the fatigue of great muscular action.

16. The best disposition of the traces in draught is when they are perpendicular to the collar; when the horse stands at ease, the traces are then inclined to the horizon, at an angle of about 15°; but when he leans forward to draw, the traces should then become nearly parallel to the road. The most proper inclination, however, is determined from the relation which subsists between the friction and the pressure, in every particular case. When a horse is employed in a gin, or in moving a machine by travelling in a circular path, the diameter of his path should not be less than 25 or 30 feet, and in most cases 40 feet should be preferred; at all events it should not be less than 18 feet.

17. The following is a useful table from Tredgold, *showing the maximum quantity of labour which a horse of average strength is capable of performing at different velocities, on canals, railways, and turnpike roads.*

Velocities per Hour.	Day's Work.	Force of Traction.	Useful effect per day for a distance of 1 mile on a		
			Canal.	Level Railway.	Level Road.
Miles.	Hours.	Lbs.	Tons.	Tons.	Tons.
$2\frac{1}{2}$	$11\frac{1}{2}$	$83\frac{1}{8}$	520	115	14
3	8	do.	243	92	12
$3\frac{1}{2}$	5,9-10ths	do.	153	82	10
4	$4\frac{1}{2}$	do.	102	72	9
5	2,9-10ths	do.	52	57	7·2
6	2	do.	30	48	6·0
7	$1\frac{1}{2}$	do.	19	41	5.1
8	$1\frac{1}{8}$	do.	12·8	36	4.5
9	9-10ths	do.	9·0	32	4·0
10	$\frac{3}{4}$	do.	6·6	28·8	3.6

In comparing this table with practice at the higher velocities, it is reckoned necessa- to add $\frac{1}{3}$ more than the useful effect, for the total mass moved. Now, the actual rate at which some of the rapid coaches travel is 10 miles an hour; the stages average about 9 miles; and a coach with its load of luggage and passengers amounts to about 3 tons; therefore the average day's work of 4 coach horses is 27 tons, drawn 1 mile, or $6\frac{3}{4}$ tons drawn 1 mile, by 1 horse. At the rate of 10 miles an hour, the table gives 3·6 tons, which increased by $\frac{1}{3}$ makes 4·8 tons drawn 1 mile, for the extreme quantity of labour of a horse at this rate, upon a good level road. To this result should be added the loss of effect in ascending hills, passing heavy roads, &c., which will make the actual labour performed by a coach horse about double the maximum given in the table. The injurious consequences are well known. *(To be continued.)*

SENSES OF INSECTS.

It was well said by the distinguished Danish naturalist, Fabricius, that "nothing in natural history is more abstruse and difficult than an accurate description of the senses of animals.*" This inherent complexity of the subject appears to have induced Lehmann to undertake the investigation of the senses of insects †. He collected into a focus all that was known previous to his time, though he has added very little from his own observation; but since that period much has been done by Marcel de Serres, Wollaston, Muller, and others.

The chief difficulty of the subject arises from the great physical differences which exist between animals furnishedwith bones and warm blood, and insects that have neither, rendering all inference from analogy much less to be depended on, than if the physical structure of each were similar. When we see an elephant, for example, use his trunk to lift a small piece of money from the ground, we cannot doubt but that he feels the coin as plainly as we should do in lifting it with the hand, and hence the inference that the trunk of the elephant is an organ of touch follows of course. But when we see an ichneumon fly vibrating its long antennæ before the entrance of a bee's nest, and sometimes even inserting one or both of them into the hole as if to explore its con- insects alluded to may be warnec of the ap- tents, we are not thence entitled to conclude that the antennæ are organs of touch, for they may, with as much probability, be inferred to be organs of hearing employed to listen to sounds produced by the inhabitant of the nest. It would also be too hasty, as it appears to us, to infer that flies, gnats, and moths, are endowed with eyes of very quick sight, because we find it difficult to approach them without putting them to flight; for the earth-worm (*Lumbricus terrestris*, Linn.) will retreat with similar rapidity into its hole when the light of a candle is thrown upon it at night,* though no anatomist has ever discovered its eyes nor believes that it has any; and the insects alluded to may be warned of the approach of danger by smell, by hearing, or by touch, from slight changes in the currents of air, as probably as by sight. Analogy, it would thence appear, is very apt to mislead; and as we have little else to go upon in the subject of the senses in insects, we can seldom ascertain the facts with minute accuracy, and must rest contented with probabilities and approximations to the truth.

Respecting one point there can be no doubt,—namely, that an object must always be present in order to produce a sensation or feeling; light and colours being in this manner the objects of the sense of seeing, and sound of the sense of hearing. In man the impression made by light upon the eye or by sound upon the ear passes along peculiar nerves to the brain, as the signal from a distant telegraph is communicated to a metropolis. In insects we may suppose that such impressions upon the eye or the ear are only conveyed to the next nervous centre *(ganglion)*, since they possess no general brain similar to ours, but a number of central points in different parts of the body where the adjacent nerves unite†. Whether, also, insects possess one set of nerves for feeling and another set for motion, as Mr. Charles Bell has recently discovered to be the case among larger animals, remains to be ascertained, though analogy would lead us to conclude that they must have something at least similar. Be this as it may, the most obvious mode in which we can discuss the subject before us, is to examine the structure of the organs, and the probable action of objects upon these. It appears to be the most convenient order to begin with the Sense of Touch, and then to take up Taste, Smell, Hearing, and Vision, in succession.

(To be continued.)

THE TAXIDERMIST.

(*Continued from page* 410.)

OF STUFFING QUADRUPEDS, &c.

Let us suppose the animal which we intend to stuff to be a Cat. Wire of such a thickness is chosen as will support the animal by being introduced under the soles of the feet, and running it through each of the four legs. A piece of smaller dimensions is then taken, measuring about two feet, for the purpose of forming, what is termed by stuffers, a tail-bearer. This piece of wire is bent at nearly a third of its length, into an oval of about six inches in length; the two ends are twisted together, so as to leave one of them somewhat longer than the other; the tail is then correctly measured, and the

* Nye Samling as det. Danske, &c. ii. 375.

† De Sensibus Externis Insectorum, p. 1, 4to., Gottingæ, 1798.

* J. R.

† See Insect Transformations, pp. 400 and 139.

wire is cut to the length of it, besides the oval. The wire is then wrapped round with flax in a spiral form, which must be increased in thickness as it approaches the oval, so as to be nearly equal to the dimensions of the largest vertebræ, or root of the tail. The thickness can be very nearly imitated from measuring the bones of the tail which have just been removed, and for this purpose a pair of callipers should be used. When finished it should be rubbed thinly over with flour-paste, to preserve its smooth form, which must be allowed to dry thoroughly, and then the surface should receive a coating of the preservative. The sheath of the tail must now be rubbed inside with the preservative. This is applied with a small quantity of lint, attached to the end of a wire, long enough to reach the point of the tail-sheath. The tail-bearer is then inserted into the sheath, and the oval part of the wire placed within the skin of the belly, and attached to the longitudinal wire, which is substituted for the vertebræ or back bone.

Four pieces of wire, about the thickness of a crow-quill, are then taken, which must be the length of the legs, and another piece a foot or fifteen inches longer than the body. One end of each of these is sharpened with a file in a triangular shape, so that it may the more easily penetrate the parts. At the blunt end of the longest piece a ring is formed, large enough to admit of the point of a finger entering it; this is done by bending the wire back on itself a turn and a half, by the assistance of the round pincers, On the same wire another ring is formed in a similar manner, consisting of one entire turn, and so situated as to reach just between the animal's shoulders. The measurement should be carefully made from the animal itself. The remaining part of this wire should be perfectly straight, and triangularly pointed at the extremity.

Another method of forming the supporting wires, as practised by M. Nicolas, is to take a central wire, which must be the length of the head, neck, body, and tail of the Cat, as in plate VI, fig. 8, that is from *a* to *b*, but the tail at *b* is shortened owing to want of room in the plate; two other pieces are then taken and twisted round the centre piece, in the manner represented in plate VI, *c. d, e, f*; these extremities being left for the leg wires. After the wires are thus twisted together, the central one is pulled out; and the feet wires of one side are pushed through the legs of one side from the inside of the skin, and, the other two leg pieces are bent and also forced through the legs, and afterwards made straight by a pair of pincers: the centre piece, having been previously sharpened at one end with a file, is now forced through the forehead and down the neck, till it enter the centre of the twisted leg wires which it formerly occupied, and pushed forward to the extremity of the tail, leaving a small piece projecting out of the forehead, as represented in the Cat, plate VI, fig. 8. After which, the completion of the stuffing is proceeded with.

We think this mode unnecessary for the smaller animals, and that it should only be adopted for quadrupeds the size of Deer, &c. These wires are besides much more difficult to insert by this than by the other method.

All the wires being adjusted, the operation of stuffing is next proceeded with. The skin of the Cat is now extended on a table; and the end of the nose seized with the left hand, and pushed again into the skin, till it reaches the neck, when we receive the bones of the head into the right hand. The skull is now well rubbed over with the arsenical soap, and all the cavities which the muscles before occupied are filled with chopped tow, flax, or cotton, well mixed with preserving powder. The long piece of wire is now passed into the middle of the skull, and after it is well rubbed over with the preservative, it is returned into the skin. The inner surface of the neck-skin is now anointed, and stuffed with chopped flax, taking care not to distend it too much. Nothing like pressure should be applied, as the fresh skin is susceptible of much expansion.

Observe that it is always the inner surface which is anointed with the arsenical soap.

Take care that the first ring of the wire, which passes into the head, is in the direction of the shoulders, and the second corresponding with the pelvis, or somewhat towards the posterior part. One of the fore-leg wires is then inserted along the back of the bone; and the point passed out under the highest ball of the paw. When this is accomplished, the bones of the leg are drawn up within the skin of the body, and the wire fastened to the bones of the arm and fore-arm with strong thread or small twine. Brass wire, used for piano-forte strings, makes it more secure, and is not liable to rot. These are well anointed, and flax or tow *slivers* wrapped round them, so as to supply the place of the muscles which have been removed. The common stuffing employed by the French taxidermists, at the Jardin des Plantes, is chopped flax; but it must be quite evident that for such parts as the legs of animals or birds, that flax or tow slivers are far preferable; and can be wound on with more nicety, whereas, chopped flax or tow is apt to make inequalities. To give the natural rise to the larger muscles, a piece of silver should be cut of the length of the protuberance required, and placed in the part, and the sliver wrapped over it. This gives it a very natural appearance.

The mode of fixing the legs, is by passing one of their pieces of wire into the small ring of the horizontal or middle supporting wire. Pursue the same plan with the other leg, and then twist the two ends firmly together, by the aid of a pair of flat pincers. For an animal of the size of a Cat, the pieces left for twisting must be from five to six inches in length. After being twisted, they are bound on the under side of the body wire, with strong thread: the two legs are then replac-

ed, and put in the form in which we intend to fix them. The skin of the belly and top of the shoulders is then anointed; and a thick layer of flax placed under the middle wire. The shape is now given to the scapulæ on both sides, and all the muscles of the shoulders imitated. These will be elevated or depressed, according to the action intended to be expressed. The anterior part of the opening is now sewed up, to retain the stuffing, and to enable us to complete the formation of the shoulders and junction of the neck. This part of the animal is of great importance, as regards the perfection of its form; and much of its beauty will depend upon this being well executed

If the animal has been recently skinned, the best plan possible is to imitate, as nearly as possible, the muscles of the carcase; by which many parts will be noticed which might otherwise have been neglected. Even to the comparative anatomist, I address this recommendation: COPY NATURE WHENEVER YOU HAVE IT IN YOUR POWER.

It must be observed as a general rule, that the wires for the hind legs of quadrupeds should always be longer than those of the legs.

The next thing is to form the hind legs and thighs, which must be done as above described for the fore legs; but with this difference, that they must be wound round with thread, drawn through the stuffing at intervals, to prevent it slipping up when returned into the skin of the leg. They are then fixed, by passing the leg wires into the second ring of the centre body wire, which is situated at, or near the pelvis; the two ends are then bent, twisting them to the right and left around the ring: and to make them still more secure, they should be wound round with small brass wire, or packthread: the tail bearer is then attached in the manner formerly described.

Having completed this part of the iron work, the skin of the thighs is coated inside with the preservative, and the stuffing completed with chopped flax or tow. The whole inner parts of the skin which can be reached are again anointed, and the body stuffing completed with chopped flax. Care must be also paid not to stuff the belly too much, as the skin very easily dilates. The incision in the belly is now closed by bringing the skin together, and then sewed within and without; while attention is paid to divide the hairs, and not to take any of them in along with the thread; but should any of them be inadvertently fixed, they can be picked out easily with the point. (Plate VI. fig. 9.) When this is completed, the hair will resume its natural order, and completely conceal the seam.

The seam should now be well primed, on both sides, with the solution of corrosive sublimate, to prevent the entrance of moths.

The articulations of the legs are then bent, and the animal placed on its feet; and pressure used at the natural flat places, so as to make the other parts rise where the muscles are visible.

I cannot take leave of this part, without mentioning a plan which I invented, for giving full effect to the muscles of the shoulders. Having skinned a Dog, immediately on removing the carcase, I took a plaster of Paris cast off, from each of the shoulders; and from these moulds I cast a pair of shoulders. After having completed the internal stuffing, I applied these casts on the top of the tow, and on the skin being brought over them, they had the best effect imaginable; and gave the complete appearance of the shoulder in the living animal. This method may be extended to the other visible muscles of the body with great effect; and it is very easily and speedily accomplished. In short, every legitimate means of this kind should be thought of and adopted, at whatever expense and trouble it may be, to obtain the end in view; namely, as close an imitation of the living subject as possible; for one well mounted specimen is worth fifty indifferently executed.

A board is now prepared, on which to place the Cat. But before fixing it permanently, the animal should be set in the attitude in which it is intended to be preserved, and the operator having satisfied himself, then pierces four holes for the admission of the feet wires, which must be drawn through with a pair of pincers till the paws rest firmly on the board. Small grooves are then made for the reception of the pieces of wires which have been drawn through, so that they may be folded back and pressed down in them, and not be beyond the level of the back of the board; wire nails are now driven half in, and their heads bent down on the wires to prevent them from getting loose, or becoming moveable.

The stuffer next directs his attention to the position and final stuffing of the head and neck. The muscles of the face must be imitated as correctly as possible, by stuffing in cotton at the opening of the eyes, as also at the mouth, ears, and nostrils. To aid in this also, the inner materials may be drawn forward by the assistance of instruments, such as are represented at plate VI. figs. 10 and 11, also small pieces of wood, formed like small knitting meshes.

Our next care is the insertion of the eyes, which must be done while the eyelids are yet fresh. Some dexterity and skill are required in this operation; and on it will depend most of the beauty and character of the head. The seats of the eyes are supplied with a little cement, the eyes put in their place, and the eyelids properly drawn over the eyeballs; but if rage or fear are to be expressed, a considerable portion of the eyeballs must be exposed. The lips are afterwards disposed in their natural state, and fastened with pins. If the mouth is intended to be open, it will be necessary to support the lips with cotton, which can be removed when they are dry. Two small balls of cotton, firmly pressed together, and well tinctured with the arsenical soap, must be thrust into the nostrils, so as to completely plug them up, to prevent the air from penetrating, as also the intrusion of moths; and besides it has the effect

of preserving the natural shape of the rose after it has dried. The same precaution should be adopted with the ears, which, in the Cat, require but little attention in setting.

We must again recommend the stuffer to see that he has sufficiently applied the preservative soap; and the nose, lips, ears, and paws, being very liable to decay, must be well imbued with spirits of turpentine. This is applied with a brush, and must be repeated six or eight times, at intervals of some days, until we are certain of the parts being well primed with it; and, after all, it will be advisable to give it a single coating of the solution of corrosive sublimate.

The methods of stuffing, which we have pointed out in the preceding pages, are applicable to all animals, from a Lion down to the smallest Mouse. Animals of a large description require a frame-work suited to their dimensions; these we will point out in their systematic order. They are also some animals, whose peculiarity of structure requires treatment differing a little from the ordinary course.

(*To be continued.*)

EXPLANATION OF THE PLATE.

Plate vi, fig. 2, exhibits the manner of inserting the wires in mounting a Cat.

Fig. 8.—The wires as they are put together before being placed in the skin; a, the tail wire; b, c, head and neck wire; d, e, and f, leg wires.

Fig. 13.—Wire employed for forming a double cross in the larger quadrupeds.

Fig. 12, exhibits the manner of articulating the joints of the large quadrupeds, in setting up skeletons. *a*, an iron plate; *b* is the nut which tightens the screw of the iron peg; *c* is the head of the second iron peg, the nut and screw of which are the same as that shown in front, and is placed behind.

THE SPIRIT OF THE INDIAN PRESS, OR MONTHLY REGISTER OF USEFUL INVENTIONS, AND IMPROVEMENTS, DISCOVERIES, AND NEW FACTS IN EVERY DEPARTMENT OF SCIENCE.

RUSSIAN INFLUENCE IN CHINA.

We observe, from the following letter in the *Bengal Hurkaru*, that Russian influence is extending in a quarter least expected.

"You observe, in your paper of to-day, that the affairs of the Foreign Barbarians in the celestial Empire, appear to have arrived at a crisis. My own impression is, that, although the present *may* be a passing cloud, the crisis will very speedily come in earnest. But why?—whence?—wherefore? Why should the "Outside Barbarians" be either more fiercely dealt upon in person, or more hampered in all their commercial transactions than heretofore? Have the Chinese Government suddenly become blind to all the benefits attending their trading relations, with the Empire? Have the Barbarians themselves been guilty of any greater contempt for the son of Heaven or of any greater violations of his edicts touching foreign dirt than they have for the past twenty years? Where then arises this sudden and loud clatter of edicts, this more than ordinary activity of respectable functionaries not to be allayed even by the accustomed bribe? We see things, but as through a glass darkly; yet a cause occurs to me, and I know not how it has escaped your attention, and that of your contemporaries, which accounts for these things. My own idea, and I should like to see it worked out by persons more capable, and better informed on such points, is—*That* RUSSIAN *influence is at the bottom of the whole.* The eyes of the great vulture are never for a moment withdrawn from the affairs of the east. Think not that her astute Government is so absurd as to contemplate a "houra" upon Bombay or Calcutta. Russia knows that, whatever she may threaten, and her official organs *do* threaten, her advance to the Indus must be by sap and mine. The creeping process of a siege with all its zig-zags, and not a rush after the fashion of Attila or Timoor. But in the meantime she may make our Indian Empire *too costly to be worth the holding*; indeed, I look upon that as the natural termination of our dominion in the East. She may embarrass our Commerce and our Finances: all that is trouble and loss to us, is gain to her.

In a memoir addressed to the Emperor by one of his diplomatic agents, credit is taken for Russian policy in contributing to those Commercial disasters in this Country from which we are but now recovering. Russia

has a College at Pekin. Do you imagine that the students who affect to be lost in the intense delight of studying the language of Tse have no other object in learning that charming tongue than interpreting at fairs on the Siberian frontier? They are withdrawn into Russia after remaining at Pekin five years and replaced by new students. It would be curious to see the information they carry away as well as the instructions from the Autocrat of all the Russias to the Freshman! Be assured that there is no lack of Muscovite roubles or Muscovite intrigue at Pekin; and to what object on earth is it so likely to be directed as the embarrassment of the most formidable of Russia's antagonists in Europe. In the last number of the Port Folio which has reached me, the attention of the British public is called to this very point. Here, in collision as we may almost say with the wolf of the north, with only a border and debateable land between us, it behoves that we be doubly vigilant.

Russia is adding two hundred thousand men to her army. Prussia is her thrall. Austria will not oppose her single-handed. France! alas for France! Louis Phillippe is her King, *not* by the grace of God. The German states are ridden rough shod by Prussia and Russia; Spain is in convulsions; Portugal a cypher. England alone can be an object of fear to Russia even for a moment. HER embarrassment, HER distraction, those are the objects of Russian policy, and Russian policy weaves its net of mingled perfidy and blood and gold, from the tropics to the poles. One great mesh is, to my mind, now looking up in China. What would not the Muscovite, no niggard paymaster, award to the fortunate agents who should shatter the prosperity of British Indian, and British European commerce in that Empire. Yea, shatter it only for a moment: for in that very moment Nicolas casts his glance around him, he sees England convulsed by the great contest of the people and the Peers; Ireland, her right arm, paralized or menacing; India crippled in her resources through Russian diplomacy in China. He sees these things—he cries march! and without withdrawing a man from his vast defensive force, two hundred thousand Scythians defile before him on that ominous road where stands Catherine's prophetic direction post, "To Constantinople!"

While Russia has a College in Pekin, we should demand at the cannon's mouth the same privilege for Great Britain, and make a similar use of it—well employed, it would be worth a thousand Amhersts and Macartneys."

ROADS IN THE EAST OF BENGAL AND CACHAR.

The *Bengal Herald* of the 29th instant has an article, by the *Reformer*, on a road from Calcutta to Assam through the Cassiah Hills. The information which it conveys is valuable, but we fear that the locality through which the route lies, will be found so unfavourable for the construction of a durable road, that the project must be postponed till other wants of more immediate importance are supplied. The whole of the tract of country which lies between the Megna and the Cassiah Hills is so repeatedly intersected with streams, that the construction of a road will be found an object of no ordinary difficulty. During the rains the road even between Dacca and the Megna is impassable except by water. From Dacca to Sylhet, during seven months of the year, the dawk is conveyed in a little dingy, and it is impossible to traverse that vast lagune except in a boat. The whole surface of the country is one sheet of water; and the villages, built on gentle elevations, have all the appearance of little islands studding a wide ocean. The first instruction given to boys and girls in that district is in the management of the paddle; and in some of the most commercial towns, the passengers cross the streets in little canoes. For a moment one might almost fancy himself transported Venice and surrounded with gondolas. Over a country of this description, no road can be carried but at an expense, which it would be unwise to incur until there is a probability of greater traffic than now exists.

The export of tea from Assam to Calcutta, will, eventually, furnish the element of a large commerce; but it is much to be doubted, whether the tea merchants would not find it more to their advantage to move down the tedious and long-winding Berhampootur, than to traverse the Cassiah Hills, with their bulky chests. There are also some awkward torrents which cross that route, and the descent from Chairra to the plainswill of itself be found a most formidable obstacle to the adoption of this road for commercial purposes. At present, moreover, those mountains are not sufficiently peopled, and are too deficient in draft cattle, to afford any adequate assistance to any active commerce. But all our ideas on the subject must for the present be necessarily vague. The provinces on our eastern frontier have hitherto been famed only for their lime and oranges, and we are therefore comparatively ignorant of the state and condition of the country. If the tea trade should assume any magnitude, a rapid and increased intercourse will necessarily commence with the metropolis, and thus constrain us to look for the most expeditious and safest route to Calcutta. One thing however is certain, that if the tea plant be discovered to grow with ease at Sadiya, and if we once acquire the mystery of manipulation, the cultivation of this plant will not long be confined to that remote and almost inaccessible province. The hills and mountains between Sylhet and Munipore which lie much nearer to Calcutta will soon be covered with tea gardens.

It is impossible to revert to these fair regions without being strongly reminded of the untimely removal of the individual, who received charge of Cachar when it was a comparative desert, and turned it into a flourishing province. The strict interpretation of the new military law which prescribed the number of officers who might be absent at

one period from their corps, deprived that country of the benefit of his services. All those who were acquainted with its condition and its wants, felt at the time that it was an unwise policy, which made the greater object bend to the less, and regarded the welfare of a whole people as subordinate to the punctilious observation of a very questionable rule. The former superintendent brought all his energies to bear upon the improvement of this interesting country; but just at the moment when he might reasonably have looked forward to the full realization of his benevolent views, he was snatched from this scene of usefulness, and buried in the dull routine of regimental duty. We offer him many apologies for thus intruding this painful subject on public attention, without his permission; but the exertions which he made to revive and reanimate Cachar are historical facts, and as such are in a measure public property; and we may, on this ground, plead an excuse for this expression of sincere regret at the premature termination of his labours.—*Friend of India, February* 2.

IMPORTANT TO MARINERS.

The following is a translation of a notice issued by the French Government, and is highly important to Navigators.

Notice to Navigators.—Navigators frequenting the coasts of Coromandel are aware that there exists at Porto Novo 10 leagues South of Pondicherry, a smelting furnace, the chimney of which is very lofty and throws out from its summit a light so brilliant as to be taken at times for a light-house.

They should be cautious of confounding this light with the one at Pondicherry, or by such a mistake they might touch the bank of Coleroon for want of water.

At the northern point of the Bank, in four fathoms, the chimney bears W. 59° N.

The best way of ascertaining whether they have reached Pondicherry as Porto Novo is after they have shaped their course to stand in boldly to the shore and keep the lead going. To the East and N. E. of the bank, the soundings diminish rapidly, in some places a fathom at a cast.

In the neighbourhood of Pondicherry on the other hand the soundings diminish gradually and uniformly.

The Bottom off the Coleroon bank is of sand and good for anchorage, if the sea breeze is not too strong.

Ibid. (Signed) A. Henry,
Lieut. of the Harbour Ship

MR. NIGHTINGALE THE NATURALIST.

We understand that Mr. Nightingale, the eminent naturalist, and Son of Sir John Nightingale, Baronet, who arrived here in the *Tigris*, has proceeded to Kandy to prosecute his scientific researches into the natural productions of the Island. Mr. Nightingale is well known to the British public as the Author of a delightful little volume "Oceanic Sketches." We are informed that the collection which he is at present making is intended to enrich the Cabinet of the Duke of Northumberland.—*ColomboObserver, Jan.* 13.

NOTICE TO CORRESPONDENTS.

Scalpel's communication will be very acceptible; it shall be printed across as desired and copies furnished. Mr. Hill's communication has been mislaid; we shall esteem it a great favor if he will kindly send us a copy for our next number. We have just received Mr. Hodgson's communication, Indication of a new genus of Insessores.

Dr. Forbes' Topographical Report of Hidgelee shall appear in the next Medical Journal. Some valuable meteorological tables will also appear.

*** To avoid double postage and the disagreeable necessity of having their copies returned to us, we shall feel obliged if our subscribers will, immediately on change of residence, inform us of their new address.

John Elmer Esq.
Thos Pakenham Esq
Capt Mansel
Progress of the Arts in India

THE INDIA REVIEW

OF WORKS ON SCIENCE,

AND

JOURNAL OF FOREIGN SCIENCE AND THE ARTS,

EMBRACING

MINERALOGY, GEOLOGY, NATURAL HISTORY, PHYSICS, &c.

REVIEW.

Memoir on the Geology of the Neelgherry and Koondah Mountains. By P. M. Benza, Esq. M. D. *of the Madras Medical Establishment.*

On the Granitic Formation, and direction of the Primary Mountain Chains, of Southern India. By Captain James Allardyce, 23*d Regiment Madras Native Infantry.*

On the Tree which produces the Gamboge of Commerce. By R. Wight, Esq., M. D.—*Madras Journal of Literature and Science, October,* 1836.

We have just received two numbers of this valuable periodical: they contain matter of deep interest to the scientific reader and afford striking proof that science is making rapid strides in India. Dr. Benza's memoir on the geology of the Neelgherry and Koondah mountains contains matter of considerable importance, of which we proceed to give an outline. It opens with a description of the group of hills, called Neelgherries, and considered as the southern termination of the western Ghauts, which at this place end in abrupt, lofty, and almost vertical precipices; the extensive valley of Coimbatore dividing them from the Paulghaut chain, which, following the same direction as the Ghauts, extends down to Cape Comorin.

The Neelgherries form an elevated plateau, projecting in an easterly direction, from the line of the Ghauts, in the form of a triangle, the base of which is the continuation of the Ghauts themselves.

They rise abruptly from the table-land of Mysore, in stupendous cliffs, with an elevation of many thousand feet. Two rivers encircle them, as it were, running round their base. The Bowany river, rising in the western side of the Koondah and among the hills of that group, runs in an easterly direction along the foot of the outside of the Neelgherries, and, just below the apex of the triangle, it is joined by the Moyar, which, together with the Pykarra, having their origin in the Neddiwattum range precisely opposite the sources of the Bowany, and making a sharp curve after leaving the hills, runs an easterly course, joining the Bowany at Danikancottah, and under that name, after running about thirty miles, they discharge their waters into the Cauvery.

The Neelgherries*, being the highest hills in the whole of the peninsula, south of the Himálaya, possess a greater degree of geo-

* "The Neelgherry Hills are situated between the parallels of 11° 10′ and 11° 32′ N. latitude, and 76° 59′ and 77° 31′ E. longitude from Greenwich; their greatest extent in an oblique direction, from S. W. to N. E. is from 38 to 40 miles, and their extreme breadth 15; taking in account the great undulations of the surface, and the breadth above stated being pretty constant throughout, their superficial extent may be fairly estimated at from 6 to 700 square geographical miles."—*Baikie's Observations on the Neelgherries.*

logical interest than any other group in this extensive region.

Their being almost in the middle of a district, in which one of the most interesting rocks in the Indian formations (the laterite) is found developed in all its characteristic features, adds not a little to their importance in a geological point of view. On account of their superior elevation, they ought to be carefully examined by the geologist, before he extends his researches to the other parts of the chain, of which they form the most elevated point. Dr. Benza says that the experienced eye of the geologist can easily guess the nature of the rock composing a hill or a system of hills, by the simple inspection of its outlines : thus, spiry peaks show the formation to be primitive ; rounded smooth outlines are indicative of calcarious mountains; while the castellated ruin-like appearance of a mountain is proper to the sandstone formation. Although the contour of the rocks forming the Neelgherries is even, smooth, rounded, and, as it were, undulating, the fundamental rocks of which they are composed belong to the primitive class. Their outline resembles those hills and eminences we meet in districts, resulting from tertiary or alluvial deposits. What the rock is, which gives those hills the rounded form they exhibit, will be shewn hereafter. With the exception of some vertical cliffs and mural precipices, seen in the boundaries of this elevated plateau, and a few projecting masses of the fundamental rocks on the summits and declivities of these hills, the whole group is uniformly covered by a thick stratum of vegetable earth (No. 1*), which, overlaying a thicker stratum of red earth (to be described in the sequel), supports numerous plants, chiefly grasses, which, growing most luxuriantly in thick contiguous tufts, give the surface a smooth carpet-like appearance. This vegetable earth in general is clay, and of a grey colour, and very friable. On this soil we occasionally see small rounded pieces of the decomposed subjacent rock, bestrewed particularly on those spots where blocks of the decomposing rocks are seen jutting through the soil. This vegetable soil is replaced in the low valleys and flats at the foot of the hills, by a black soil, such as we frequently see forming the peat-bog in swampy grounds, in which a large quantity of vegetable matter is being decomposed. This soil is of a black, or deep brown colour; of tenacious consistence, when moist; crumbling into powder, and often splitting into prismatic masses, when dry. At first sight it resembles the black soil of the plains of India. From this last, however, it seems to differ greatly, in containing a large quantity of carbonaceous matter, and much oxide of iron. To deprive this black soil of the greater portion of its humidity, Dr. Benza exposed it to a heat, sufficient to melt lead, and, after having weighed a certain quantity of it, subjected it to an intense heat for an hour ; after this, it had lost more than 25 per cent. of the original weight, and had changed into an ochrey red powder. In many other localities the author remarked a most luxuriant vegetation of innumerable ferns, of which the roots are seen decaying into a black powder. Our author's attention was greatly excited to see (at Kotagherry) those tubular bodies traversing the thick stratum of black earth, which overlays the yellow clay, without having a particle of it in their composition. As if the roots, by a kind of capillary attraction, sucked up through the black soil, without mixing with it, the particles of the yellow clay which, undisturbed by the vicinity of the black soil, arranged themselves concentrically to the root ; and the latter decaying has left the cavity of the tube empty.

Immediately below the vegetable soil, in almost all places, we find a stratum of detritus (in general not above a few inches thick), which is different in different localities, according to the nature of the rock

* The figures refer to illustrative specimens presented for deposit in the Mineralogical Cabinet of the Madras Literary Society—*Editor*.

on which it rests. Thus, it is ferruginous on those places where iron ores are found: quartzy and silicious above the thick veins of quartz, which intersect these rocks. Below the detritus, in almost all places on the hills, Dr. Benza found a thick stratum of an ochreous red earth, which occasionally assumes both the appearance and the composition of lithomarge, and for this reason the author hereafter indiscriminiately denominates it either lithomargic, or red earth. In general, this red earth is of a mottled colour, or streaked with different hues of red, yellow, crimson, white, and grey or brown. It feels unctuous to the touch, and crumbles into dust when pressed between the fingers. It does not form a paste with water, but subsides to the bottom of the vessel. The different colours of this earth are separate and distinct, having a decided line of demarcation, so as to show that they are produced by the decomposition of separate and distinct minerals. This red lithomargic mould is evidently the result of the decomposition of two of the rocks, which almost exclusively form the Neelgherries; viz. the sienitic granite, and the hornblende rock, or primitive greenstone. Dr. Benza, after visiting and examining the summits of some of the highest hills, found a variety of pegmatite forming many of the most prominent rocks on them. Such are the summits of Doodabetta, Elk Hill, Kaitee pass, some of the peaks of the Koondah, and probably many other places which he did not visit. It is undoubtedly to some of the erratic blocks and rolled masses of this rock, or to the decomposition of those beds of pegmatite, into which the true granite of the high hills seems to pass, that the porcelain earth is owing. Of these blocks, still in an undecomposed state, many are seen in the valley of Kaitee; derived, in all probability, from the summit of Doodabetta, or from that of the rock of Kaitee where the pegmatite is seen *in situ*. Our author states that the porcelain earth is not to be confounded with that which results from the decomposition of the pure felspar veins, so frequently seen in the sienitic granite. He found it between two large blocks of decomposing sienitic granite, or rather hornblende rock, with garnets, close to the bund of the lake. Alluding to magnetic iron ore, he states that the two places on the Neelgherries, where he had seen this ore very rich in metal, are, one near the village of Vartsigiri (Kotagherry), and the other close to, and traversing, the lake of Ootacamund in two places. The specimen from Vartsigiri is very compact and rich in metal. He took it from a large block, probably the outgoings of a thick bed at the southern extremity of the valley, at the other end of which the village stands. The appearance, composition, and proportion of the ingredients of this magnetic iron ore are very different in different places; nay, in the same vein. Dr. Benza mentions that it is the belief of some people, that owing to the similarity of the rocks, of the detritus, and of the quartz veins, of the Malabar coast, and of these hills, gold may be found in this last, as well as in the former. Iron ores are so common on these hills, independently of the oxides of that metal contained in the minerals forming the rock, that many springs of water are of the chalybeate class*. The next species of iron ore on the Neelgherries is the hæmatitic, forming immense beds, and sometimes whole hillocks, among the hornblende rocks, and sienitic granite. The most extensive formation of this hæmatitic iron ore is seen on both sides of what Sir F. Adam calls Scotland Valley.†

The rock of the Neelgherries is by no means so cavernous, and has not so many tubular sinuosities as the laterite of the Carnatic, Northern Circars, &c.; it seems also to be richer in metal, and, what appears to constitute a marked difference, it is entirely divested of any quartz, or sandy particles, which abound so much in the laterite of other places. Dr. Benza alludes to the opinion of Dr. Heyne, that in the laterite

* Baikie's Observations on the Neelgherries, page 14.

† Sir Frederick Adam, Governor of Madras, called it by that name, on account of a resemblance he saw in it to some place in Scotland.

of the Red Hills, Nellore, &c. a marl or carbonate of lime is occasionally one of the ingredients; no traces of this carbonate are found in the stone of the Neelgherries. That this rock of the Neelgherries is to be classed with hæmatitic iron ore, rather than with the true Indian laterite (an overlaying rock), is very probable, considering that rocks similar in appearance to it are found in Europe, while the last is peculiar to India. Hitherto no organic remains have been found in this rock on the Neelgherries, which appears also to have been the case with the laterite of the other parts of the peninsula. Under the name of laterite two, or rather three, sorts of rocks are included; to say nothing of the common mistake of misapplying the name to the decomposed rocks of the primitive class, or to any other that has a red, ochreous colour, and softish consistence. The third species, which abounds all along the intervening land, from the foot of the western Ghauts to near the sea-shore, resembles very much the modified hæmatitic iron ore (not the pisiform), being cavernous, not tubular, abounding with quartz pieces and sand; having not only the cavities lined with powdery felspar, but, in the compact portion of the rock, having small pieces of the same mineral in the compact state. Dr. Benza is not positive regarding the existence of manganese on these hills. Colonel Cullen says, that it is found mixed in the iron ore near the lake.

Dr. Benza found a straggling piece of this ore in the valley of Kaitee, which he has not analysed, but which has the external characters of one. True granite, composed of felspar, quartz, and mica, is not of rare occurrence; it frequently occupies the summits of the highest hills: thus it is seen in some of the Koondah range, and of the Doodabetta group; Dr. Benza never saw it, except in the form of erratic blocks, in the low valleys. The sienitic granite varies in the proportion of its component minerals, and therefore in appearance; it sometimes approaches diabase (primitive greenstone), and at others, granite. It almost always contains garnets as one of the minerals composing it; and when this mineral is abundant in the rock, the quartz diminishes in proportion. In some places, the garnets, instead of being either amorphous, or in angular crystallized pieces, assume the granular form, resembling colophonite; in which case, the rock containing it assumes a stratified appearance, and at others being lamellar, and of the dodecahedral species; in this case, it resembles cinnamon-stone, or essonite. Descending from the Kaitee pass towards the valley, after the second turn of the road and not a hundred yards from the huge mass which overhangs the road, Dr. Benza came upon a thick vein of quartz, intersecting it nearly in an east and west direction; and, on examination, he saw that it contained numerous veins of titaniferous iron ore.

The rounded oblong hill, on the sides of which the new road is constructed, and which is intersected by the vein of titaniferous iron ore, is formed of the granitic rock, which prevails in all the eastern range of Kaitee; viz. an unstratified rock, composed of four minerals in general, hornblende, granite, felspar, and quartz, occasionally, in some masses, a few plates of mica.

The vein of quartz appears to extend from the eastern to the western nullahs; and, although protruding in the eastern side of the hill, it does not reach so high as the surface of the convex summit of the hill. Dr. Benza found in the western nullah some straggling pieces of the same ore. The breadth of this titaniferous vein is 250 ordinary paces, measured in the cut of the road; and, although evidently unstratified, yet, in some of the masses, particularly those in which there are many veins of the ore, it puts on an appearance of stratification. In general the composition of the vein is this—the quartz is granular, and, when mixed with a great quantity of the ore, becomes friable, crumbly, and full of little cavities, the greatest number of which are full of an ochreous, or yellowish earth. But the same rock, in other parts of the vein, assumes a great degree of hardness, although having the same appearance as the friable one, but with less metal. The

titaniferous iron is contained in thin ramifications through the quartz; in some places alternating in laminar plates of certain thickness with it; in others in thin strata by itself. It is sometimes seen like a black, shining varnish over the surface of the stones; but, chiefly, in thin veins traversing the rock not exceeding a few lines' thickness. Occasionally, between the metal and the quartz, in the seam, there are little irregular cavities, the metallic side being lined sometimes with a most brilliant green, precisely the colour and brilliancy of oxide of uranium; at others, golden, scarlet, red, or, lastly, it has a jet black, velvety *enduit.* The titaniferous iron has a semi-conchoidal fracture—the lustre is adamantine, and, in some of the specimens, glimmering—it scratches glass—alone it is infusible before the blowpipe, but forms with borax a reddish globule, in which the particles of the metal are still seen, changed into the same colour —not magnetic, even after the action of the blowpipe. These two last qualities, together with the probability of its containing uranium, would make this metal approach to nigrine or iserine, more than to menaccanite. Judging by what we see in the bank of the road, this metal cannot be scanty in quantity. In this locality our author also found two pretty large loose pieces of an iron ore apparently different; fracture scaly—it shines brilliantly—is powerfully magnetic, and looks like chromate of iron. Descending into the hollow, at the head of Kaitee Valley, Dr. Benza found numerous large masses of a granitic rock, in which it is interesting to observe some portions of them entirely composed of sienite, and others of regular granite; in both kinds the felspar being red. Many other masses (loose) were formed of a fine grained greenstone, which, when struck, rung powerfully. To finish the description of the whole valley of Kaitee, it only remains to say a few words, regarding the tract which extends from the farm to the waterfall. This cascade is about four miles from the farm, and is formed by a small river, resulting from the waters of the valley. This valley, although undulated with numerous eminences and hillocks, offers a very poor field for the geologist, their surface being uniformly covered by a thick stratum of red earth, and all rocks and asperities in the formations concealed beneath this stratum, which gives them all a tame, smooth aspect. Following the course of the river, within a quarter of a mile of the waterfall, we meet with immense tabular masses, slightly convex, of hornblende slate, scarcely above the level of the soil, over the middle of which the water of the river flows. The strata are nearly vertical at this place, and the water has cut a passage in them, making a kind of trough. This has not been effected by the mere erosion of the rock by the water, but by its displacement in the following way. On arriving at the waterfall, the ledges forming the steps, down which the water precipitates itself, are clearly stratified; there are two cascades, a very romantic parterre intervening between the two. It seems that this last spacious ledge is formed by immense tabular masses, or strata, placed in a horizontal position; while those, which recede perhaps a hundred feet back, and then rise abruptly two hundred feet or more, forming the walls of the first fall, are vertical, and in them there is an excavation, similar to the one already described; its depth being ten feet, but its length not exceeding one half of the former; specimen is from its side, which is the usual hornblende slate. The rock which prevails in the Kaitee range, as well as in other places, is the one which abounds with hornblende and amorphous garnets. These last sometimes are of a large size, and not dispersed through the rock, but, as it were, in nests. Although this primitive greenstone is occasionally seen on the summit of some hills, in general it occupies the declivities or the lowest parts of them; and it often assumes a brilliant, laminar crystallization, being then exclusively formed of hornblende. Dr. Benza has seen it passing into hornblende slate at the foot of the Neelgherries, at the bottom of the Koonoor pass. Going from Ootacamund, towards this Seven Kairn's hill, a few hundred paces before the junction of these two rivers, a little to

the right of the path, our author perceived a small knoll, forty or fifty feet above the level of the river, extending from the S. W. On the uppermost convexity of this knoll, are erected two enclosures for cattle, now probably deserted, no human habitation, for miles round the place, being seen. The floor of these enclosures is formed by an immense ledge of rock, which, in their interior, is level with the soil, and on the outside, rises a few inches above it. The rock appears unstratified, at least what is visible of it, and its composition is the following: lamellar garnets, some of them half an inch in diameter, which have the appearance of the dodecahedral species of that mineral—cinnamon-stone, or essonite. Of all these minerals it seems that the cinnamon-stone is the most liable to decompose, or disintegrate; since we see, in some parts of the surface of the mass, small cavities, in consequence of the falling out of the disintegrated crystals of this mineral. This rock is very compact, exceedingly heavy, and takes a brilliant polish.

In the Koonoor pass, not more than a mile from the bridge down the pass, and just below the village of Koonoor, in the road, many of the blocks which have been blasted, are traversed by a dyke of basalt. This basalt is very compact; has a dull, even fracture; but, in one portion of the dyke, Dr. Benza, had the opportunity of observing that the part which was in contact with the granite had the appearance of a crystalline hornblende, which passed into compact hard basalt towards the centre of the dyke. Another enormous dyke of this rock is seen in the chain of hills which connects Doodabetta with Kaitee pass. The summit of the hill, which is between those two mountains, is formed of basalt in huge masses, some of which affect the prismatic figure. In general the large blocks are not so compact as the thin ramifications of the dyke traversing the rock, but the hornblende in the former is nearly granular and shining, somewhat approaching primary greenstone. About two miles from Ootacamund, along the Neddiwattum road, there is a small rivulet, close to the road, the first met in this direction. A basaltic dyke, like a ledge, half in the water and half out, is seen in an oblique position, N. E. and S. W. dipping north. On ascending to the summit of this hill, which extends in the usual rounded form eastward, we see that it is entirely formed of basalt, in a dyke probably a diramation of that of the rivulet, and extends all along the small ridge for nearly a quarter of a mile. Basaltic dykes are not rare in those places, which Dr. Benza had an opportunity of visiting in the plains of India. He has seen them through granite and gneiss in Mysore; through porphyry, near the euritic hill of Pallicondah; through hornblende slate, near Mateepolliam; through porphyry, near Garabunda (Northern Circars), and in many other places. Following the Koondah road, in less than a mile we come upon the continuation of the magnetic iron ore, which, intersecting the lake, extends to this place, very much altered in appearance and composition, looking more like a stratified ferruginous sandstone, than the continuation of the metallic vein near the lake, many of the strata being contorted and waving and containing hardly any metal. Descending from the eastern Koondah pass, and crossing the field, a little knoll is seen, traversed by a basaltic dyke in an east and west direction; it is flanked by, and has burst through, sienitic granite, crossing the road: on ascending the ridge opposite to the Avalanche, this landslip comes at once to view. There has evidently been no sinking of the land in the declivity of the hill; but it seems that a thick stratum of the rock, lying almost vertically on the declivity of the hill and between which and another the present rivulet runs, whose waters having undermined the stratum (which might have overlaid thick beds of clay, the result of the decomposed rock), the weight of the superincumbent mass, together with the almost vertical position of the stratum, made it *slip*—hurling rock, soil, and jungle into the valley below, leaving a deep ravine, bounded to the north by a mural precipice of undecomposed rock.

some hundred feet high, and to the south by the remainder of the declivity, which is seen undisturbed in its place, having the same latitude as the opposite boundary. On ascending the Ghaut, the view from all points of the ascent is described as really grand. Dr. Benza does not recollect having seen anywhere such a wild, yet magnificent, spectacle as the ravine formed by the two hills—the one of the Avalanche chain, the other one of the eastern range of the Koondahs. The thick impervious jungle, extending its whole length, occupies also the lower half of the steep declivity of both the hills, and is then succeeded by the usual carpet-like covering of dense turf, which extends to the very pinnacles of their prodigious altitudes. While ascending this pass, at every turn of the road a most striking and superb *coup d'œil* presents itself—the nearly vertical side of the Avalanche hill, with its precipitous battlement-like summit—the enormous prismatic masses, three or four in number, bursting, as it were, through the turf-covered soil of the steep declivity of the hill; one of which, in particular, looks like a huge martello-tower stuck to the nearly vertical side of the mountain—while the magnificent ravine to the left completes the striking view before us. This assemblage of wild and grand objects cannot but produce sensations of wonder and admiration. On arriving at the gorge of the pass, of course the view, becoming more expanded and enlarged, has a superior degree of beauty, particularly that of the extensive undulated table-land, of which the Doodabetta group to the east, and the Koondah and Himigala ranges to the west, are the boundaries. The expression *undulated* table-land is used, because such is the appearance of that tract of the country, seen from such a height, although many of these apparent undulations have thousands of feet of elevation. The rock composing the Avalanche hill is hornblende slate in the declivities, which passes into sienitic granite, and to true granite at the summit, with much mica. In ascending from the bungalow to the gorge, Dr. Benza observed basaltic dykes, in more than one place, and thick beds of pegmatite. But when ascending from the gorge to the summit of the Avalanche hill, the greatest number of the projecting rocks was granite, mica having entirely replaced hornblende. In the opposite hill of the Himigala range, is seen a pretty cascade, which, although of no great dimensions, yet, having such stupendous scenery as a back ground, and the water precipitating itself down eleven steps formed by the strata of hornblende slate, making as many cascades, has, if not a grand, at least a romantic effect. Judging from the numerous rolled masses of basalt in the bed of the Koondah river, into which the cascades fall, trap must be of frequent occurrence in these hills which join the Avalanche with the Himgala range.

Descending a mile along the banks of the Koondah river, the traveller joined the new road. Its foot, facing the Avalanche, is washed by a small river, the protruding rocks in the bed of which are granite, are composed of felspar, golden mica, and a little smoky quartz. It is a fine-grained rock, of a greyish black colour on account of the dark hue of the quartz. Half way up the hill are three large basaltic blocks, implanted in the soil, the fracture of which is glimmering, on account of the numerous needle-shaped crystals of augite entering into its composition. In more than one place thick beds of black soil underlay the vegetable mould, on the declivities of hills, and always in the low valleys. Five or six miles from the eastern Ghaut, we come to a round backed hill, all formed of the lateritic iron ore, precisely similar to that in other localities on these hills. Descending this hill, the author came to a valley, which, on account of its great length, is called *Long Valley*. The greater number of blocks jutting above the soil (at this side of the Koondahs the hills have the same rounded appearance as those of the Neelgherries), on both sides of the valley, are schistous diorite, mixed with many others which are granitic, composed of the three usual minerals. The rocks from this place to Sispara are granite, decomposing and decomposed.

We have thus given an abstract of Dr. Benza's paper and shall resume our notice of it in our next.

We proceed to give an abstract of the next article by Capt. Allardyce.

The circumstance most remarkable in the INDIAN GRANITE FORMATION is perhaps the great prevalence of that kind of rock called primitive trap, greenstone, or hornblende rock;* it does not form, as in other countries, patches of limited extent, but surrounds and intersects the whole peninsula; it seems to have its regular place among the granitic strata, with which it is confluent at the line of junction, passing gradually from green to red and white felspar rocks: it generally cuts off and terminates all the other granites. Possessing this character, it may be considered the oldest rock here unfolded in the granitic series; for if the primitive mountains are the subverted fragments of a formerly horizontal crust, which all observation and experience tend to prove, then, according to the laws of subversion that prevail in the more recent formations, the stratum found encompassing the others will be that which was earliest formed and originally undermost in the series.

The primitive trap, together with its associate the small-grained sienitic granite, is by far the most extensive and continuous of the Indian rocks†. On the western coast it seems to extend uninteruptedly from Surat to Cape Comorin, or rather to Ceylon, for the mountains there appear to be of the same character as the western Ghauts, and are besides nearly on the same line. From Ootacamund to the N. E., at least as far as Madras, this rock extends in full character; but does not constitute the mass of the eastern Ghauts at Nakanary, which in this respect differs from the western chain. The mountains of the Northern Circars are said to form a very continuous and well-defined range of trap hills, but elsewhere in the line of eastern Ghauts, or between Salem and the Kistnah, the strata appear to be of various kinds. Connecting the western Ghauts at Surat with the eastern at Balasore or Ramghur, is the Vyndiah range also of this trap: so that the trap or green felspar rock appears to surround the peninsula on every side. Numerous similar and smaller chains cross the interior, generally in a direction S. W. and N. E. Travelling westward from Palaveram, where green felspar prevails, we do not again meet with the same rock until reaching the western Ghauts on the opposite coast. The identity of the Palaveram rock with that of the western Ghauts, the dissimilarity of the eastern range at Nakanary, and the non-occurrence of the green granite in the intermediate space, are circumstances indicative of a particular arrangement.

The direction of stratification at Ootacamund, on all the hills near the cantonment, is W. S. W.* at Trichinopoly the same, and at Nakanary not very different. The lines of stratification cross the Ghauts diagonally at Nakanary, or, perhaps more

* The Palaveram rock is a good example of the primitive trap: being nearly allied to sienitic granite, it appears to be sometimes distinguished by the same name; it has been called also primitive greenstone, hornblende rock, and gneiss when distinctly stratified. The composition is, in most cases, at least two thirds felspar, of a bottle green colour, or usually some shade of green, which changes to a light sandstone hue in decomposition; mica, quartz, garnet, hornblende, and schorl also occur, but in minor proportions, the essential ingredient being felspar. In the western Ghauts near Goa this trap consists of a paste of bluish grey felspar with scarcely any other ingredient, perhaps the distinguishing mark of trap that will apply most generally is its difference in texture from granite; the one being a compact vitrious paste, the other a more freely granulated compound---in this sense the term is here used, for any definition founded on origin or manner of eruption will not hold good with regard to the primitive traps.

† If sienitic granites are to be distinguished by the presence of hornblende, it will be found that, according to the present unlimited application of the word, there is scarcely a granite in this part of India that might not be included as sienitic: but, if we regard them simply as intermediate between granite and trap, it is better at present, for the sake of perspicuity, to drop the dubious term sienitic granite, and pass on to the trap, which will include the granites next to it having a close texture and vitrious aspect.

* An exception to this occurs on the north side of the cantonment where the direction of a piece of gneiss or rather trap more stratified than usual runs N. and S. and has fallen besides to an angle of 45°., the dip being to the westward. This fragment includes at least three small hills, the convexity and exfoliation of which have the usual direction with regard to the horizon, and are not influenced by the oblique position of the rock.

strictly speaking, the line of fracture running N. and S. crosses diagonally the lines of stratification. We see from this that there are mountain ranges having their stratification parallel with their direction, and others having it oblique; it will follow also that if disruption take place across lines of subverted strata, a variously composed ridge will be the result; whereas, if the dislocation proceed parallel with the subverted strata, there will be in consequence a continuity of the same rock elevated. This is a rule that will be found to hold good in most cases as applied to primitive strata, and, where secondary ranges occur, the subjacent rock is more to be considered as the true mountain ridge than the overlaying crust. The Gujunder Ghur hills, for example, although a sandstone range, are based on granite; owing their superior elevation to the rising of the granite underneath: another example is the sandstone of the Naggery hills. It has been remarked that while the primitive trap ranges, with the exception of that on the western side (namely, the Ghauts), have a tendency N. E. and S. W., inferior ranges supporting secondary strata run more N. and S.—it requires observation to prove how far this is the case.

Throughout the southern part of the peninsula, igneous rocks greatly prevail, there being scarcely a trace of aqueous strata; and among the primitive rocks clay-slate is wanting, although it is found in abundance further north: in certain places clay-slate and limestone tracts, of the transition series, are of vast extent, and, considering the almost invariable presence of valuable metallic ores in such districts, they are not the least interesting in a commercial point of view.

In the Konkan north of Goa the elevation of the Ghauts is clearly pointed out as subsequent to the formation of laterite: the table-land is covered with a thick crust of this substance, as well as the lower level of the Konkan: and hills, which appear rising from the low ground as detached portions of the table-land, are flat-topped, with a crust of the same laterite, while their slopes, like the general escarpment of the Ghauts, are covered only with a loose debris.

The Carnatic, and several other similar tracts, occurring along both coasts, are, as granitic plains, surprisingly level: the slight tertiary diluvium with which they are covered, cannot be considered as a principal cause of this uniformity, for the rock itself is everywhere found near the surface: every appearance here indicates that the granitic formation has at one time been a great deal more flat than it is generally understood to have been. The Neelgherries rise from a plain nearly as level as the Carnatic, and their summit bears evident marks of having been once on a level with the Mysore and Coimbatore plains. Like elevated regions in other parts of the world, the Neelgherries shew also traces of a diluvial current; that is, the gravel and loam are arranged in such a manner as could only take place by deposit from water; the gravel being lowest in a thin stratum by itself, with the lighter loam covering it, to the thickness of several feet, and without gravel. The carbonaceous black cotton soil occurs here as on the plain, and it is found under the general gravel line as well as above, shewing it to have been lodged among the broken strata, before the passage of the later diluvial current over the surface: the indications are that this current has passed before the hills attained their present elevation, which last seems an event so recent, as to be only anterior to the formation of kankar. As no secondary strata occur near the Neelgherries, none need be expected on their summit; but, on the eastern Ghauts at Naggery, sandstone is found, and serves to point out that the hills there have been elevated since the sandstone period. It is probable that the other parts of the Ghauts have been raised about the same time: every thing tends to show that the elevation of these ranges is a comparatively recent event.

Geologically viewing these chains in conjunction with the table-land, it appears that the surface, nearly as far to the eastward as Salem, has been forced to a considerable height, with the Cauvery ranges

for its boundary; but beyond this it breaks short of the trap ranges, and the dislocation runs north, through the interior of the basin or compartment, towards Nakanary. The fracture, in this instance, departs from its usual course, and excludes the northern part of the Carnatic from the level of the table-land. The eastern Ghauts preserve nearly the same character, until reaching the latitude of the Naggery hills, where green felspar strata again occur. The connection of these with the Ghauts might be determined by taking their direction; as long as the direction of the strata continues E. and W., while that of the ghauts is N. and S., a progressive change or succession of strata may be looked for: and different rocks, which originally had nothing to connect them into a mountain chain, receive, by cross fracture, the new character of elevation in a common line.

Of the Himalayan chain we are told that the principal valleys are perpendicular to its direction, running N. E. and that the escarpments are generally on the N. W. side, while the S. E. is shelving; but we are entirely ignorant regarding the direction of strata, whether the chain in its progress crosses many different kinds of rock in succession, or whether there are continuous rocks of any one kind extending from Bootan to Cashmere. Gneiss is said to be the most predominant of the primitive rocks, and strange to say "gneiss reigns paramount in the Andes": the fact seems to be that all granite, when fully exposed to view in large masses, is more or less stratified; and hence is as liable to be called gneiss as granite. Much of this gneiss may on comparison prove the same as our primitive trap, which appears to be a very widely extended rock, for green granite is mentioned as entering into the composition of the Hindoo Koosh.

The next paper we shall quote is on remarks on the TREE WHICH PRODUCES THE GAMBOGE OF COMMERCE in consequence of the following observations on it, by Dr. Graham, Professor of Botany in Edinburgh, communicated by him in a letter dated 12th March, 1836.

"In consequence of having received specimens from Mrs. Walker of the tree which in Ceylon yields gamboge, I have been attending to the subject lately, and, on Monday last, read some observations to the Royal Society (of Edinburgh) about it. I have been obliged to dissent wholly from Arnott and you, that it is the *Xanthochymus ovalifolius*, and Arnott now agrees with me so far, but he has fallen into at least as great a blunder. It is undoubtedly, as I think, the *Garcinia (Mangostana* Gœrt.) *morella* of Desrousseaux and Gœrtner. Arnott now thinks it *Garcinia Zeylanica*, which it cannot be, if Roxburgh describes this with any degree of truth. In fact the *Garcinia morella*, which I have said it is, is no *Garcinia*. Murray says the tree is *Stalagmitis Cambogioides*, but his description will not apply to my plant, from which I have a great quantity of excellent gamboge. I have sent a specimen to Mr. Don to request that he will compare it with the specimens in the Bankean Herbarium, from which Murray's description was taken. If the same, the generic name *Stalagmitis* may yet be retained, and the description only altered. If not the same, it must form the type of a new genus, to which I find *Garcinia elliptica* of Wallich also belongs; it is especially characterized by the stamens, of of which I send you a figure."

The point on which Dr. Graham finds it necessary wholly to dissent from us is thus briefly stated at page 102 of the Prodromus. "There can now be little doubt of this *(Xanthochymus ovalifolius)* being the only plant in Ceylon that yields gamboge fit for the arts, and that consequently the specific name of *Gambogia gutta* Linn. ought to have been applied to this species and not to *Garcinia Cambogia*."

The evidence contained in Dr. Graham's letter seems so completely to invalidate the correctness of our statement, that it might appear useless to attempt any refutation; yet I am not satisfied that he is either wholly right, or that we are wholly wrong. I do not think him right in considering the tree of which he has got specimens, as the only one that produces gamboge fit to be used in the arts, nor do I think it is the one which produces the true Ceylon gamboge. I do not think so, because it has been long and well known, that there are two sorts in use, one from the eastward, Siam, Cambogia, China; and the other from Ceylon: the latter considered inferior to the former. The gamboge, from the tree in question, specimens of which I have seen, is apparently of the best quality, and much superior to the common Ceylon gamboge, having a fine, rather light, colour and glassy fracture. The

true Ceylon gamboge is darker coloured, and mixed with dark brown spots. The Ceylon tree which produces the fine gamboge is rare, as Colonel Walker informs me he has only met with it in one place, and that an old garden near a former Dutch settlement, not far from Negombo. It cannot surely be supposed that a tree, so exceedingly rare as this is represented, can be the one which affords all the gamboge produced in that island, still less so when it is borne in mind, that that obtained from it differs in quality from that usually produced there, and known in commerce under the name of "Ceylon gamboge." From these facts I think we are entitled to conclude, that Dr. Graham has drawn a wide inference from insufficient data, or, in other words, has attempted to form a general rule from a solitary example. I do not, however, wish it to be supposed, that I insist on our statement being held strictly correct, because a degree of uncertainty attaches to the tree or trees from which this substance is procured, that all the efforts of botanists for the last century have been unable altogether to remove; all that I have attempted, or indeed wish to prove is, first—that facts adduced by Dr. Graham are not sufficient to invalidate our position, that the *Xanthochymus ovalifolius* is the only, *indigenous* plant in Ceylon that produces gamboge fit to be used in the arts; though I fear, from further enquiries, that we were premature in hazarding so strong a statement; and secondly—that the tree, from which Dr. Graham's specimens were procured, is of exotic origin. I shall now attempt to account for the appearance in the island of that tree which is neither a *Garcinia* nor *Xanthochymus*.

About the beginning of the 17th century, the Dutch first imported gamboge into Europe from China, and, not long after, they expelled the Portuguese from Ceylon, and formed setlements of their own there, which they retained until near the end of the 18th century. Is it at all unreasonable to suppose, that, in the course of that long period, they should endeavour to procure from their own territories a lucrative article of commerce, in place of having to purchase from others all, of the finer sorts, required for their European trade? If not, we may readily suppose they imported the plants above referred to, and which have remained unnoticed by the English, until Colonel Walker accidentally discovered them about two years ago, in just such a situation as one might expect to find introduced trees, namely, in a garden close by a Dutch settlement. A most interesting discovery it is, since it seems to prove that they are of exotic origin, that the soil and climate are suitable for its growth and propagation, and leaves room to infer, that it might be introduced with success on the west coast, at least, of India, the climate of which corresponds in many respects with that of the south-west coast of Ceylon; and, lastly, because, it, in part at least, sets this long agitated question at rest, by making us acquainted with the probable source of the best gamboge used in the arts.

Botanically considered, this plant presents some points of considerable interest, which may be the means of directing more of the attention of botanists to the peculiarities of the order to which it belongs, than it has hitherto received.

Dr. Graham shows that his plant is not a *Xanthochymus*, neither is it a *Garcinia*, and, unless there is an error in the description, that it cannot be a *Stalagmitis*, but that it forms a new genus, essentially characterised by its stamens, the filaments of which are united into a single square column, and the anthers one-celled, opening at the apex by a calyptra, or lid, in place of two-celled, bursting longitudinally, as in all the other genera of *guttiferæ;* characters amply sufficient to separate it from every other genus of the order.

To the conviction expressed that this new genus is undoubtedly Gœrtner's *Mangostana morella*, I can offer no objection, as I am altogether unacquainted with that plant, except through the figure, and because Dr. Graham has not stated the evidence on which he grounds this conclusion; but if it should prove correct, I must acknowledge it goes far to establish the fact of its being a native of Ceylon, and, consequently, that the juice of it, as well as of other trees, may be drawn for gamboge as that of *Garcinia pictorea* *Roxb. Another member of this new genus is in Malabar.

Here the question must for the present rest; as it can only be finally decided by reference to authentic specimens of the plant described by the older botanists (who usually paid much attention to useful plants), as the "Arbor Indica *Gummi Guttam* fundens," and which has now been bandied about from species to species, till it seems to have multiplied itself into about half a dozen different trees; but I trust that Ceylon botanists will now be induced to take up the subject in earnest, and ascertain, by actual inspection and the preservation of specimens, the tree, or trees, for there may be several, from which its gamboge is derived, and further to determine whether the trees, which have given rise to this fresh agitation of the question, are of indigenous or exotic origin.

While writing on the subject, I shall avail myself of the opportunity to offer a few observations on the essential characters of the genera, named in the above remarks, namely *Garcinia*, *Cambogia*, *Mangostana*, *Stalagmitis*, and *Xanthochymus*; with the view of directing attention to some points of structure, which, it appears to me, have not been sufficiently attended to in the construction of these genera, giving rise, in consequence, to much confusion and uncertainty as to the species that ought respectively to belong to them.

In 1737, Linnæus published his genus *Garcinia*, formed from Rumphius' *Mangostana*, assigning as its essential character 16 stamens *(Dodecandria)* and an eight-seeded berry. In 1748, he published, in his Flora Zeylanica, *Cambogia*, assigning to it numerous stamens (Polyandria) and a pomacious, eight-celled and eight-seeded fruit. Pomum 8-loculare, semina *(i. e.* in each cell,) solitaria. In 1789, Professor Murray of Gottingen published his genus *Stalagmitis*, assigning to it a quaternary proportion of sepals and petals, pentadelphous stamens, and a one-celled, three-seeded berry. In 1791, Gœrtner attempted, from an examination of the fruit of three species, to reform the Linnean genera, and, on carpological characters, united *Garcinia* and *Cambogia* under Ramphius' name *Mangostana*, assigning to his new genus a quaternary proportion of parts, indefinite stamina, and a four to eight-seeded berry. This genus, with the exception of the name, has been adopted by all succeeding writers. In 1798, Roxburgh published his *Xanthochymus* (Cor. Pl.), well distinguished from the former by its quinary proportion of parts; five sepals, five petals, five fascicles of (pentadelphous) stamens, and an unequal (three to five) seeded berry. The characters of all these genera, it may be observed, are, with the exception of the last, incomplete, owing to the authors having overlooked their polygamous inflorescence, and neglected to avail themselves of the peculiarities of the male flower; an imperfection not felt, so long as every plant of the order, with a quaternary proportion of organs, was referred to *Garcinia*, but to which, now that a new genus is added, agreeing in that particular, it is necessary to attend: the more so, as some of the species of *Garcinia* approach the new genus by having their stamens united into a head; while others approach *Xanthochymus* by having theirs fascicled, and are only to be distinguished by their proportion of parts. It is of great importance to attend to proportion in this tribe, as we are thus enabled to discover what Murray's *Stalagmitis* really is. We have seen that Roxburgh's *Xanthochymus* has a quinary proportion of parts, pentadelphous stamens, and an unequal (3-5) seeded fruit. In *Garcinia* the quaternary proportion prevails with an equal (4-8-12) seeded fruit. In *Stalagmitis* both are said to be combined, an union, which all must acknowledge to be most improbable.* Petals and sepals are deciduous, or, may be carelessly examined; not so the fascicles of stamens, they are small, and must be examined carefully if to be seen at all, and the number of seeds are not subject to accidental loss in drying or examining. The quinary proportion of stamens and uneven number of seeds afford, I think, almost irrefragable proof of the identity of *Stalagmitis* and *Xanthochymus*, the petals and sepals only being erroneously described.

This view is confirmed by Mr. George Don, in his edition of Miller's Dictionary, having reduced Roxburgh's *Xanthochymus* to *Stalagmitis*, I presume on the authority of Murray's own specimens which he could examine in the Bankean Herbarium; an arrangement in which we, not sufficiently adverting to his opportunity of determining the identity of these genera, did not think it safe to follow him. By thus uniting *Garcinia* to *Cambogia*, and *Stalagmitis* to *Xanthochymus*, the confused assemblage is reduced to two very distinct genera. The only question that remains to be considered is, whether or not it is advisable to leave them as they now stand."

Art. II.—Sugar, as to the probability of an improvement in the cultivation and quality of, either through Europeans or Natives, in case of an increased demand: from the report of the select committees of the Houses of Lords and Commons, appointed to enquire into the present state of the affairs of the East India Company, 1830-31.

Bell's Comparative View of the External Commerce of Bengal, during the years 1834-35 *and* 1835-36, *pp.* 106.

A Treatise on the Cultivation of Sugar-canes, and the manufacture of Sugar; comprehending instructions for planting and saving the cane, expressing

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* Since writing the above I find that Roxburgh describes the flowers of *Xanthochymus ovalifolius*, as having occasionally four sepals and four petals, which identifies it with Murray's *Stalagmitis Cambogioides*, the Ceylon Camboge plant of that author.

the juice, &c. &c. By W. Fitzmaurice, *many years a planter in the island of Jamaica, pp.* 69, 1830.

The nature and properties of the Sugar-cane, with practical directions for the improvement of its culture and the manufacture of its products. By George Richardson Porter, *Philadelphia, pp.* 354, 1831.

A Dictionary, Practical, Theoretical, and Historical, of Commerce and Commercial Navigation: illustrated with Maps and Plans. By J. R. McCulloch, Esq. *Second Edition, Corrected throughout, and greatly enlarged: with a Supplement, supplying the deficiencies and bringing down the information contained in the work to October*, 1835. *8vo. pp.* 1327. Longman, Rees, Orme, Brown, Greene, and Longman, London, 1835.

(Continued from page 558.*)*

The soil most favorable for the production of sugar-cane, is a mixture of clay and sand, or what is called brick-mould.

"Although the effects of rain on this soil are apparently soon over, its surface quickly drying, the inner portion retains a considerable degree of moisture even in the driest weather, and it has the advantage of seldom requiring trenches to be made even in the wettest season.

This soil very much predominates in St. Domingo; in Jamaica it is confined to particular districts, and even in those districts to particular spots.*

Next to this, black mould of several varieties is favourable for the production of the cane. There is a species of this mould in Jamaica, which abounds with limestone and flint on a substratum of soapy marle. Black mould on clay is more common, but it is generally only in a very thin stratum, and the clay is tenacious and retentive of water: this last sort of land, therefore, requires great labour, both in ploughing and trenching, to render it profitable; but, properly pulverized and manured, it becomes extremely productive.

The best black mould is found in Barbadoes, Antigua, and some other of the Windward Islands. But the very best soil for the production of sugar of the finest quality, and in the largest proportion, is the ashy loam of St. Christopher's. The alluvial soil of Guiana is most favourable to the vegetation of the cane, but not to the elaboration of its saccharine juice, except in old settled plantations having the benefit of the sea-breeze without receiving its spray.

Canes will not flourish on a merely sandy soil: to make them grow there, requires a great expense for manure, as well as frequent rains, or the command of water for irrigation.*"

"When land is unproductive, we should inquire into the cause of its sterility, which must necessarily result from some defect in the constitution of the soil."

"In such cases, the cause can only be ascertained by chemical analysis; then the noxious principle which exists will be easily discovered, and most probably easily destroyed. If any of the salts of iron be found present, they may be decomposed by lime. If any inert vegetable matter be indicated, this can be removed by lime, paring, and burning. If there be a deficiency of vegetable matter, it may be supplied by manure. If there be an excess of silicious sand, a mixture of marle will eminently correct it.

In stiff, heavy soils, chalk and sea-shells are used with great advantage. Low, swampy grounds, besides the assistance of lime, chalk, or sand, according to the nature of the soil, should be well drained, and every facility given for the escape of the stagnant waters, and the overplus of those which collect after storms."

"Lime is beneficial to almost any soil, particularly new and especially where the salts of iron are found.†

Where carbonate of lime already exists in the soil, lime and chalk are useless, inasmuch as there is little or no undissolved vegetable matter.‡

Marle§ mixed with sandy clay materially improves the soil. It is understood that the

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* Plant-canes in this soil have been known in very fine seasons to yield two tons and a half of sugar per acre.—*Edwards's West Indies.*

* There is, however, a peculiar sort of land on the north side of Jamaica, chiefly in the parish of Trelawney, that cannot be passed over unnoticed, not only on account of its scarcity, but its value; few soils producing finer sugar. The land alluded to, is generally of a red colour: the shades of which, however, vary considerably, from a deep chocolate to a rich scarlet; in some places it approaches to a bright yellow, but it is every where remarkable, when first turned up, for a glossy or shining surface, and if wetted stains the fingers like paint. *Ibid.*

† Wood sorrel, coarse tufts of grass, and various sour herbage, indicate the presence of oxide of iron, in Europe.

‡ Lime should never be applied with animal manures, unless they are too rich, or for the purpose of preventing noxious effluvia. It is injurious when mixed with any common dung, and tends to render the extractive matter insoluble.—*Ure's Dictionary of Chemistry.*

§ Marle, a mixture of clay and carbonate of lime.

agriculturists of the West India Colonies are now better acquainted with the advantages they possess, and use these valuable substances, wherein some of the Islands abound.*

In a loamy soil (which consists of sand and clay,) lime may be used with advantage.

Lime acts immediately in producing beneficial effects, chalk not so soon, but it is more permanent in the advantages it affords to the soil. In this country about two hundred bushels of lime are found sufficient for each acre, and from fifteen to twenty of two-horse cart loads of chalk per acre.

These are to remedy the defects of soil. Animal and vegetable manures are to renovate worn out lands, by supplying new soluble and gaseous matter, for the nourishment of the plant. This is not a permanent good, and requires to be constantly renewed; as it is found by universal experience, that vegetable and animal substances, used as manure, are *consumed* during the process of vegetation.†

The properly manuring of lands is a most important operation in sugar planting; even the best soil requires occasional assistance, and there is much yet to be learnt by agriculturists in the management of this most essential branch of husbandry.

The Chinese appear to understand the matter better than most other people: every animal and vegetable refuse, every thing of disgusting appearance and offensive effluvia, they carefully collect and use as beneficial agents in vegetation, thus converting the loathsome and revolting, into the wholesome and inviting.

The sugar planter might advantageously follow the example of the Chinese in this respect. Great improvidence and waste are too often practised, and the land, as a necessary consequence, suffers.

The cane trash, which is used as fuel, would make excellent manure, and therefore it is of importance to be as economical in fuel as possible.*

The lands are at present imperfectly manured, and yet very frequently cattle are kept for the sole purpose of providing manure. Recourse also is obliged to be had to supplies from England, and much compost is sent out from this country to the Colonies.

The manure which is used, is generally a compost made of

1st. The coal and vegetable ashes drawn from the fires of the boiling and still-houses.

2d. Feculences discharged from the still-house, mixed up with rubbish of buildings, &c. &c.

3d. Refuse or field trash, that is, the decayed leaves and stems of the canes.

4th. Dung obtained from the horse and mule stables, and from fixed and moveable pens.

5th. Good mould collected from ravines, or gulleys, and other waste places.

The first is supposed to be a manure in itself for cold and stiff clays, and it is the custom, in some places in which this soil is found, to carry the ashes out in autumn, and place them, unmixed in large heaps. When the land is holed, a quantity of about fifteen or twenty pounds is put into each hole, and mixed with the mould, at the time the plants are put into the ground. But ashes thus applied cannot be very beneficial, as they neither afford soluble matter for the nourishment of the plant, nor correct any defects of the soil. In very wet lands, ashes may prove advantageous, absorbing the superfluous moisture, but then they should be spread outside, not be mixed with the earth.

The compost is used in the same manner as ashes, not being carried to the land till just before it is required. The moveable pens are, however, the chief dependence of the Jamaica planter; in the Windward Islands manuring is more carefully applied. From all cares on this subject, the colonists of Dutch Guiana are at present exempt, as their soil can be efficiently manured, as well as irrigated, by admitting the rivers to overflow the lands, the deposit which these leave being very fertilising. But as the process is attended by the production of unhealthy miasmata, it would perhaps be to their advantage to renew the fertility of their front

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* Perhaps Bryan Edwards drew their attention to this matter by asking, "Why for instance are not the manures of lime and sea-sand, which abound in these Islands, and have been found so exceedingly beneficial in Great Britain, brought into use? Limestone alone, even without burning, (the expense of which might, perhaps, be an objection,) has been found to answer in cold, heavy, and moist lands; no other trouble being requisite than merely to spread it over the ground, and break it into small pieces by sledge hammers. Of this the quantities are inexhaustible. Marle is another manure of vast and general utility in Great Britain. It enriches the poorest land, opens the stiffest, and sweetens and corrects the most rank. Lands have been raised by the use of this manure from two shillings per acre to a guinea annual rent. Now there is no country under the sun. wherein a soft unctuous marle more abounds than in Jamaica."—*Edwards's West Indies.*

In the present day, however the Jamaica planter takes advantage of the fortunate circumstance of possessing these substances, and more or less employs them all.

†These can only nourish the plant by affording solid matters capable of being dissolved by water, or gaseous substances capable of being absorbed by the fluids in the leaves of vegetables.

The great object in the application of manure should be to make it afford as much soluble matter as possible to the roots of the plant; and that in a slow and gradual manner, so that it may be entirely consumed in forming its sap and organised parts. *Ure's Dictionary of Chemistry, Art. Manure.*

* Cane trash .... which we reckon the richest manure we have, when properly prepared.—*Sir John Laforey.*

lands by manure, rather than by a process so unhealthy; and we have reason to believe that this opinion is every day gaining ground.

A moveable pen is made of light railings tied together, and to posts fixed firmly in the ground, enclosing a piece of ground proportionate to the number of cattle to be turned into it; at the end of a week it is shifted, by leaving one side standing, and moving the other three sides on the opposite face of the remaining side, thus enclosing a second piece: into this fresh enclosure the cattle are turned for another week. In this manner it is moved every week till the planter gradually goes through his whole estate, and follows it up by turning up the soil for tillage. This is considered a very advantageous practice; indeed, some overseers entirely trust to it, and give the ground no other dressing.* But it is by no means sufficient on plantations that have been much worn and exhausted by cultivation. In Barbadoes the practice is to tether cattle to stakes driven into the ground. The spot is covered with good mould, and then well littered with dry and green vegetable matter, which, with the animal manure from the cattle, make a compost heap sufficient for a certain space of ground. When this is completed the stakes are withdrawn, and placed in another part of the field, in which the same process is renewed. By this system much animal and vegetable manure is accumulated on the fields to be manured, but as much labour is required to bring mould and dry and green vegetable matter to form successive layers, some planters adopt the Jamaica plan of moveable pens already described.

The common allowance of manure where this branch of husbandry is best understood, is a cubic foot to each cane hole, but it is obvious that no precise rule can be laid down as to the most beneficial quantity to be used. This must depend upon the nature of the soil, and upon the quality of the manure. Much less of this, properly prepared, and in a fit state for use, will, of course, be required, than of that which has the fertilising principle in an inferior degree.

In employing manure, we must endeavour to procure for the canes, not the greatest possible, but the most profitable vegetation, for a too luxuriant growth is prejudical to the elaboration of the saccharine juice. If too little be used, it is unavailing and lost. The canes are then soon scorched up, the sun causing the rapid exhalation of those few aqueous parts, which a too weak vegetation has only had the power of forming, and the saccharine juice becomes closely united to an empyreumatic oil, which entirely vitiates it.

* In hilly and mountainous districts, it is considered impracticable to manure in any other manner. Then the pens are made in a somewhat more durable manner, and the cattle remain in them, till they have furnished manure for a greater portion of land than that in which they are enclosed.

It is requisite to allow the lands occasionally to lie fallow. This is found to restore them as much as the usual quantity of manure. But the weeds must by no means be suffered to gain dominion over them while in this state, since these exhaust the land as much as those plants which are useful.*

Much difference of opinion has prevailed as to the state in which manure ought to be ploughed into the ground; whether recent, or when it has gone through the process of fermentation. Those who have considered the subject chemically, entertain no doubts; and the great authority of Sir H. Davy seems to be conclusive, that recent manure is most valuable. As soon as dung begins to decompose, it throws off its volatile parts, which are the most valuable and efficient. Dung, which has fermented to a mere soft cohesive mass, has generally lost from one-third to one-half of its most useful constituent elements.† Perhaps, however, it would be advisable to allow a slight degree of fermentation to take place before it is exposed, in divided quantities, to the scorching heat of the tropical sun. The Guadaloupe planter, whom we have just quoted, strongly deprecates the pernicious practice (as he terms it,) of using recent manure in hot climates. The Barbadoes system of making manure permits a certain degree of fermentation to take place previous to its application to the soil, whilst it is covered with mould until it be so applied; thus preventing the action of air upon it to a certain extent."

* I have made a number of experiments upon the advantage of allowing the ground to lie fallow. The successful results of all these have confirmed me in the adoption of this method. Among others, I made trial upon two pieces of ground of the same nature and quality, the one situated in the highest part of my plantation, the other on the sea coast. These two pieces received two ploughings during the six months they were fallow; and, planting them afterwards, without any manure, I obtained very superior crops; but the canes of the sea coast were better than others. This observation induced me to put into each hole of a neighbouring piece of ground some sea-water at the time of planting, and the experiment succeeded admirably.—*De L' Exploitation des Sucreries.*

† To prevent manures from decomposing, they should be preserved dry, defended from the contact of the air, and kept as cool as possible.

All green, *succulent plants*, contain saccharine or mucilaginous matter, with woody fibre, and readily ferment. They cannot therefore, if intended for manure, be used too soon after their death.

If dung cannot be immediately applied to crops, the destructive fermentation of it should be prevented very carefully.

The surface should be defended, as much as possible, from the oxygen of the atmosphere; a compact marle, or a tenacious clay, offers the best protection against the air; and before the dung is covered over, or, as it were sealed up, it should be dried as much as possible.—*Ure's Dictionary of Chemistry, Art. Manure.*

Regarding the culture of the sugar-cane, in addition to the opinion given by Fitzmaurice, we shall in our next advert to that afforded by Porter.

Art. III.—Narrative of a Residence in Koordistan, and on the site of Ancient Nineveh; with Journal of a Voyage down the Tigris to Bagdad, and an Account of a Visit to Shirauz and Persepolis. By the late Claudius James Rich, Esq., *the Hon. East India Company's Resident at Bagdad, Author of "an Account of Ancient Babylon."* 2 *Vols. Octavo.* James Duncan, *Paternoster-Row,* London, 1836.

(Continued from page 577.*)*

Our author states that the population of Toozkhoormattee is estimated at about 5000 souls. Towards the latter end of April, the thermometer stood at 6 a. m. at 64°, at noon 70°, and at 3 p. m. 66°; wind south east, blowing hard. Our travellers quit Toozkhoormattee in May. We find nothing worthy of notice until our author alludes to the Kifri hills.

"The easternmost branch of the Kifri hills (which is, in fact, the main trunk or artery) passes by Kerkook, and Altoon Kiupri, thence runs off below Arbil to the Tigris, and is there called the Karatchukdagh. This eastern branch contains gypsum and naphtha. The Western, or Metara hills, are pure sandstone and gravel, and resemble in every respect the Hamreen chain most completely. They offer many circumstances worthy of note. On entering them in the pass of Jumeila, we rode through a ridge or two of perfectly vertical strata, looking as if they had been forced up into their present position. These are succeeded by some perfectly horizontal strata, also of pure bare sandstone, large blocks of which have tumbled out, and are strewed about; the rest look of a crumbling texture; and indeed the whole range bears strongly the appearance of a mountain in ruins. We next came to inclined strata, and, what is curious, the inclination of it is exactly as at the Hamreen. These hills slope to the east, at an angle of 60° from the vertical, or 30 below the horizontal. All the strata, throughout the chain, are exactly parallel, and have precisely the same direction, as if they had been drawn with a line N. 45 W. The ascent is very gentle, in an easterly direction; but winding in the narrow clefts worn by the rain in the sandstone.

We reached at twenty minutes before eight a dismal plateau, or wide extent of gravelly ruins, in heaps, and wild-looking furrows. Our road through it was N 50 E. At eight we came to other ridges of inclined strata, answering the former description; but more and more covered with gravelly soil as we advanced. Here and there were patches of barley. We met a small Koordish caravan, laden with myrtle (mord), packed in bags; it gave out a delicious fragrance. It is used, I believe, in the dyeries.

The soil and gravel now predominated, as in the east face of the Hamreen; and at a quarter before nine we reached a spot, overlooking the plain of Leilan, where the hills slope gradually and gently down."

Capt. Rich relates a custom prevailing among the Persians and Turks which belong to the people of this country, that is, of the villagers keeping their grain in pits or wells near the village, which, when covered over and levelled with the soil, cannot always be discovered, even by the native armies, without some one to show them the spot. The country between Leilan and Kerlook is a perfect plain, with several artificial mounts scattered all over it. Travelling along the Leilan stream, its course is marked by a succession of hills, each of which has a small round tower of stone attached to it, which makes it look like a little fort. In one, a miller was crying out 'Ver, Allah!' Give, God!—the constant practice when the mill is empty; upon which those who have grain to grind bring it to the mill. Our travellers reach the mount of Tchemtchemal, from which Captain Rich surveys the country and gives the following description of the Koordish ranges of mountains.

"The line which we see immediately before us, extending from N. to S. E. is a narrow precipitous bare ridge, which is called the Bazian mountains. To the north of the pass of Derbent i Bazian, which, as I have already remarked, is just before us, the mountains soon make a turn towards the west, where they form the mountains called Khalkhalan, which bound the Pashalik of Keuy Sanjak on the south. To the south of the pass of Derbent, the ridge is continued in a straight line south and a little east. Here is another pass called Derbent i Basterra; beyond which the ridge, continuing in the same line, assumes the name of Karadagh, and becomes well wooded. Here is the third road into Koordistan from the plains of Assyria. It is called Seghirmeh, or ladder, and, passing directly over the crest of the mountain, has been esteemed difficult, if not impossible, for an army.

Abdurrahman Pasha, the late governor of Sulimania, fortified all these passes, at the time he was endeavouring to render Koordistan independent; but having been defeated at Derbent i Bazian by Kutchuk Suliman Pasha of Bagdad, his fortifications were demolished. Karadagh is bounded by the Diala. Just south of the pass of Basterra, the Zengheneh hills come out west from the Karadagh, and are at first much lower: but turning south, as if to form a parallel line with Karadagh, they become of an almost equal elevation. Just behind this part, that is E. of it, appears a higher summit, belonging to I know not what range, which is part of the district of Dilleo. Just before, or W. of the high part, which to appearance forms the termination of the Zenghaneh range*, are little hills, scarcely discernible; where is Ibrahim Khanjee, and Ghilli on the Turkish frontier. Still farther W., the Kifri and Toozkhoormattee line of hills is seen coming up to unite with, but a little in the rear of, the Kara Hassan hills we have just left; which are prolonged a little to the N†. They then disappear by turning west; and leave an open horizon, as far as the Khalkhalan hills.

There were no villages discernible from Tchemtchemal mount, they being all situated in hollows, by the sides of the little streams. The villagers are all now dispersed about, in little encampments of black tents, for the convenience of pasturing their cattle, and attending to their harvest. All cultivation in Koordistan is watered solely by the rains‡, there being no artificial irrigation.

Thermometer—5 A.M. 49°; 2 P.M. 79°; 10 P.M. 59°. During the day, light N.W. breeze, night calm.—The cold was so great last night as to be pretty severely felt by our relaxed frames, though the thermometer at 2 P.M. was 79: it however continued only half an hour at this height."

Arriving before Sulimania, Capt. Rich is visited by the Pasha, a plain, reasonable, mild, and gentleman-like man. The following is our author's description of his entrance into Sulimania.

"*May* 10.—This was the morning which the astrologers seemed to have decided upon as the proper one for my entering into his capital, and public reception by the Pasha. About half an hour before the appointed time, the celebrated Osman Bey, about whom I had heard much, the Pasha's younger and more dashing brother, came to conduct me into town, accompanied by all the members of council on horseback, and an immense party of Koords on foot. The Bey was magnificently mounted on a very fine Arab horse, which he got from the Anazee Arabs, and which is said to have cost him 13,000 piastres.

All the people were gaily clad. I was much struck with the appearance of the Bey. He was not large, but lightly and well made; the outlines of his face were perfectly regular; he had a crispy or wavy black beard, dark blue eyes, with black eyebrows and lashes, and a manly tint of brown over a fine, clear, and ruddy complexion. He was altogether a very handsome young man. In horsemanship, and all their favourite military exercises, he is said to be unrivalled among his countrymen. He is likewise famous for his courage and generosity; but, on the other hand, he is reported to be rather dissolute in his morals, and tyrannical in his disposition.

He met me with an easy and polite address, in which was something of frankness but not the most distant tincture of coarseness. He was perfectly well bred in his manners. I could see he was well aware of the advantages of his person. He was magnificently attired in the Koordish taste; his gown was of a rich, flowered, gold Indian stuff; he had a superb Cashmere shawl ornamented with gold fringe on his head, put on in a wild loose manner; his upper dress was a capot, or cloak, of crimson Venetian cloth, with rich, gold frogs, or bosses, on it. The age of Osman Bey is thirty-two; that of his brother, the pasha, thirty-five. Their mother is a sister of Khaled Pasha, and consequently also of the principal branch of the Bebbeh* family.

Osman Bey was disposed to talk rather more freely of the state of Koordish affairs than I chose to encourage; and it was easy to perceive he was not of the Turkish party. He looked at his watch several times in the course of the interview, and seemed anxious that we should not miss the precise moment of mounting. At last, when they told him it was the appointed instant, we rose together and set forward in the following order:—

First a guide; then my trumpeter and standard-bearer†; then three led horses, followed by my imrahor, or master of the horse; next came my tchaoushes, or running footmen, fully armed; after whom marched the sepoys with their drum and fife. I followed, mounted on *Finvar*, with two stirrupholders, armed with battle-axes and shields; then came Mr. Bellino and Dr. Morando; then Osman Bey on his beautiful Arab, with a line of about three hundred Koords after him on foot: after the bey and his people came the members of the pasha's council: my khaznadar, or treasurer, and mounted attendants, closed the procession.

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* Having a lateral view of the Zenghaneh hills, I could see that the strata of all parts of that range incline to the E. in the same manner and degree as the Hamreen mountains.

† The road from Kerkook to Derbent, called the Ghisheh Khan road, passes over these hills.

‡ The kind of cultivation which is carried on by means of rain is called by the natives Dem, which is an Arabic word. Rice and cotton must be artificially watered in countries where there are no tropical rains.

* The name of the pasha of Sulimania's clan; so called from their ancestor, Bebbeh Suliman.

* The standard of the cross was borne by a Turk, and English marches were played by a Persian trumpeter, who was no bad performer.

We moved forward, in very good order, towards the city, if such it might be called, which was not above a quarter of a mile off. The crowd assembled to witness the procession was immense. I did not think the town could have contained such a multitude; yet the most perfect order prevailed. The police-officers of the darogha's* train dealt around, I thought very unnecessarily, sundry blows with their heavy clubs, each one of which seemed sufficient to have felled an ox. Yet I alone appeared to be annoyed at this mode of opening the march; the Koords, on whom the blows fell like hail, received them on their heads and shoulders with as little feeling as an anvil. In this manner we arrived at the palace; the entrance to which is low, mean, narrow, and dirty, to a degree which I thought ill accorded with the residence of a governor, or even of a common individual: but I understood that it is not without its use in a country like this, and that it renders the seat of government defensible, in cases of emergency. The entrance does not lead to the front of the palace, but turns round the side of it†; and here I was obliged to alight, as we could get no farther on horseback. We advanced up a handsome flight of steps into the hall of audience, which, had it been in good repair, would really have been a superb room. It was open in front on pillars‡. The pasha met me at the door, and conducted me to a chair at the upper end of the room. Mr. Bellino and the doctor were seated just below me, on chairs likewise. The members of council, headed by Osman Bey, sat on a broad nimmud, or thick felt carpet, on the opposite side, and my people arranged themselves interspersed among the pasha's officers, who were in double rows all round the room, in the centre of which stood the Ishik Agassi, or master of the ceremonies, with his staff of office in his hand. A crowd of well-dressed Koords filled the passages and the court below outside the room. After the introductory compliments, the pasha saw I admired the room, and remarked that it was built by his late father; that it wanted repair; but, said he, "Who will repair what he is not certain to enjoy; and what may in a few days afterwards be ruined by the Turks or Persians?" He told me the palace owed its elevated situation to its being built on an artificial mount, of great antiquity.§ The view from it was very agreeable. I endeavoured to keep off politics, and to lead the pasha to speak upon the economy and antiquities of Koordistan; and I happened to make a fortunate hit at the outset. I told him I had heard that the Vali of Sinna* was of a Gooran family; and the Gooran race† were not so much esteemed as clansmen. A murmur of applause burst instantly from all the attendants and went round the room. My fortune was now made with the clannish Koords; and the pasha, with more than his usual vivacity, went at once into the history of his family. He said, in the first place, that the Vali of Sinna's family was very ancient and of an honourable clan. The name of his clan, he added, was Kermanj, Bebbeh being the appellation of his own particular family, the members of which are the hereditary chiefs of the clan; and hence their whole territory and people are now called the government of the Bebbehs or Babans. The clan was originally established at Pizhder, in the northern mountains near Sikeneh on the frontier of Persia. An ancestor‡ of his, he said, had rendered important services to an Ottoman sultan in a war with Persia; and obtained in recompense an investiture of all he could conquer. He and some succeeding chiefs gradually possessed themselves of districts they now hold, with several others which have since been retaken by the Persians; and the whole was then erected into the banner of Babon, or Bebbeh, and made dependent on the pashalik of Shehrizoor, the capital of which was Kerkook. The pasha could not give me any dates, he only knew that his ancestors were lords of the Banner for a long time; and were finally made pashas of two tails not quite a century ago. He told me the Gooran race were easily distinguishable by their physiognomy, and by their dialect of Koordish. We had much more conversation of this kind, and parted exceeding good friends; and all the pasha's cousins, that is, his clansmen, seemed to look upon me with great satisfaction.

At the door I found a handsome horse, well caparisoned, prepared for me, which I could not dispense with accepting: it was accordingly led before me. And we now went to inspect the house which had been prepared for us: this was close by the palace, and turned out to be a very dismal place; spacious enough indeed, but ruinous and filthy. Such as it was, it was the dwelling of one of the chief officers of the palace, who had been dislodged to receive us. My repugnance to take possession of it was, I believe, very visible. After some whispering between the Koords and my people, the pasha sent his prime minister to request I would let my khaznadar or treasurer go about with one of

* The chief of the police.

† There is a better (but still crooked) entrance in front of the palace, which is now under repair.

‡ This kind of apartment is called a Talar.

§ Probably the fellow to those I had remarked at Tchemchemal, Derghezeen, and Taslugee.

* The governor of the province of that name in Persian Koordistan.

† The people of Koordistan are divided into two different races: the one consisting of the tribes, the other of the peasants or Goorans.

‡ It was Suliman Baba, or Bebbeh. He went to Constantinople about one hundred and twenty-five years ago, A. D. 1678, and becoming celebrated for the services he rendered the Turks against the Persians, his family were afterwards called by his name, Bebbeh or Baban, instead of the name of their tribe, which, as has been already observed, is Kermanj.

his officers, and choose any house in the town, the owner of which should be instantly dislodged to make room for me: but I could not bear the idea of this; and, besides, I was unwilling to give any further trouble. I considered that the difference in the dwellings here must, after all, be inconsiderable; and that the pasha had, in all likelihood, in the first instance, done the best for us he conveniently could: I therefore resolved to make a virtue of necessity, and put up with the proposed house; and immediately saw that my determination gave general satisfaction.

I now, therefore, sent Minas to escort Mrs. Rich into town, for the Koords had a great objection to my returning back again to camp to-day. It was easy to see that they had some superstitious idea of ill luck to their affairs if I left the town; so I passed, till Mrs. Rich's arrival, two or three hours very unpleasantly in walking and lounging about, which confirmed the nervous headache with which I had been threatened in the morning.

The description of our house will serve for that of all the better sort in Sulimania; it is a square building of one story, standing on a basement of about three feet high, and built of bricks dried in the sun, having a plastering of mud mixed with chopped straw over the whole. One or two rooms inside have been white-limed over the mud coating. The roof is flat, and is formed by rafters, reeds, and a coating of earth. This house stands in a large open enclosure, or as we would say in India in a compound: this is subdivided into two courts by a cross wall, which joins the house at each side near its centre, leaving the front in one enclosure and the back in another: this makes the Haram* and Divan Khaneh †; but there is no communication between them by a door in the house itself, as in all Turkish houses; you must go round by a door in the wall which divides the compound into two: this is peculiarly inconvenient in bad weather. The area of both courts is covered with grass, and planted with willows, poplars, mulberries, and rose bushes, interspersed in little bouquets. A stream of water runs through the court of every house in Sulimania, which is supplied from the mountains by a kahreez or aqueduct. With respect to the distribution of the rooms, it seems regulated by no plan, at least I am not able to discover any order or contrivance in it; only that in both the haram and divan khaneh is a *talar*, or room quite open in the front, which is the general receiving and sleeping room in summer. No one but the poorest persons, who have not such an accommodation in their houses, sleeps on the roof. Some, indeed, in the greatest heats, which only last a month, use a sekoo, or low platform, for that purpose; and, during summer, many construct tchardaks, or huts made of boughs, over a little tank in their own court-yard, or else pitch a tent, to escape from fleas, which are a terrible nuisance all over the East, and are said to be particularly formidable here.

In the divan khaneh part of the house is a large vacant space or hall, supported by posts, and almost dark: this is said to be a cool retreat in summer, but the pest of the fleas must still exist, and another still worse, that is scorpions, which are said to be numerous, large, and venomous. Centipedes are also found here, but I believe are not much dreaded; nor are the snakes, which are large and numerous, said to be venomous.

The winter rooms of the house are entered by a long dark passage: their appearance does not render one desirous of a nearer inspection; indeed, I keep as much as possible on the outside of the house.

The ordinary houses are mere mud hovels, which makes the place look like a large Arab village: they are perfectly exposed, but the people do not seem to regard this, the women going about with the men, and performing their domestic labours without any veil. This miserable-looking town, however, contains five khans, two good mosques, and a very fine bath. The population of Sulimania is estimated by the best judges among the Koords at ten thousand souls, including the officers of government and retainers of princes residing here. The ordinary citizens are of the peasant race.

As soon as the baggage arrived, I pitched a large two-poled tent for a divan or receiving room; and when ornamented with my arms, and covered with a handsome carpet and nimmuds*, which the pasha was kind enough to send me, it made altogether a kind of barbaric receiving hall of no contemptible appearance —certainly much pleasanter and better looking than any room in the town. The sepoys pitched tents also in the court; and some of the people, who did not relish the appearance of their quarters, followed their example.

In the haram our preparations for the first night were not so fortunate. We tried the most airy-looking room; but alas! the heat, close smell, and swarms of sand-flies soon showed us the folly of our attempts, and we drew our beds out into the talar: here again we were unsuccessful in our efforts at repose. We were kept awake till daybreak by these Koordish tormentors; though a few hours' sleep would have been a real blessing to me in my state of nervous pain.

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* The women's apartments.

† That part of the house where the master receives his visitors, and in which the men servants reside.

* Narrow strips of thick soft felt, handsomely ornamented with various colours, which are placed round the rooms in Persia and Koordistan, and serve instead of sofas and chairs.

Thermometer—5 A. M. 62°; half past two P. M. 75°; 10 P. M. 68°; south wind in puffs; disagreeable feeling day; a little rain."

Capt. Rich states a remarkable fact that the peasantry in Koordistan are a totally distinct race from the other tribes, who seldom, if ever, cultivate the soil; while, on the other hand, the peasants are never soldiers. The clannish Koords call themselves Sipah, or the military Koords; but the peasants have no other distinguishing name than Rayahs, or Keuylees, or villagers. The following is a description of a partridge fight.

"In the afternoon Mahmood Masraf came to entertain me with a partridge fight. This is a very favourite diversion of the Koords; and the Masraf, who is a famous sportsman, when he heard that I had never seen a partridge fight, was quite delighted to have an opportunity of showing his collection of game partridges, which is a very fine one. He came first, attended by four of his sons, all very fine tall young men. The old gentleman looked quite respectable amongst his fine family; and he was not a little pleased at my making the remark.

"Oh, sir" said he, "I have three or four more of the lads in the house, who will have the honour of kissing your hand one day." I was surprised to see the *un-eastern* freedom of the sons before their father. They all put themselves at their ease, and smoked their pipes without the least ceremony. From what I had seen among the Turks and Arabs, I should not have thought they would even have sat down in the presence of their father.

After a round of coffee and pipes had passed the approach of the *army*, as the old gentleman called it, was announced by a prodigious cackling and crowing of the partridges, which was audible for a great distance off; and soon a party of stout Koords appeared, bearing on their shoulders thirty two cages, each containing a cock partridge. The collective and incessant cackling or crowing of this party caused a strange noise, something like the ticking of a thousand immense watches; they were not silent an instant, except when fighting. A number of *lads of the fancy* followed, all eagerness for the sight; and more would have rushed in, if, to spare the clubbing and cudgelling, by which alone they could be kept back, I had not ordered the doors to be closed.

The cages were placed round so as to form a ring, behind which the spectators stood; the old Masraf, his sons, and myself closing the circle on the side of the tent. The scene would have suited the pencil admirably; but as it would be out of the question to attempt to sketch on the spot, I must see the sight a few times before I can attempt to give a graphic idea of it.

One of the assistants now opened the door of a cage, and let out a bird, who whirled himself up in the air as if in defiance, and then strutted about, waiting for his adversary. Another partridge being let loose, they fell to. The sight was amusing and by no means cruel. It was highly entertaining to see the little birds strut about on tiptoe in defiance, jump up, bite at each other, play about to seize a favourable opening, and avoid letting their adversary take hold on a bad place. I observed the great feat was to get hold of the nape of the neck. When a partridge succeeded in seizing his adversary in this manner, he would hold him like a bull-dog, and sometimes lead him two or three times round the ring. Sometimes a bird would be frightened and run away out of the ring. The battle was then fairly lost; and the bird so beaten will not feel disposed for fighting for two or three months afterward. Every bird had its own name; and their wings were not clipped. They were so tame as to allow themselves to be handled without resistance; and when a match was over, the birds would return to their cages almost of their own accord. They never spurred; all their attack was an attempt to seize their adversary. The Koords looked on with great interest; but after the novelty was over, it seemed to me but a puerile diversion. The Koords are keen sportsmen in horse-racing, partridge, ram, and dog fighting. Mahomet, like a true Arab, made it lawful to lay money on horse-racing; but the Koords carry the license still farther, and allow of betting on their partridge and dog fights.

After the exhibition was over, two officers came to report themselves, as appointed by the Darogha to command a patrole of fifteen men, who were to keep constantly going round the outside of our house all night. To enable them to pass our Sepoy posts, they had made themselves acquainted with "Who goes there?" and—"A friend." It was really curious to hear Koords in Sulimania endeavouring to pronounce these English words, which they had learnt from Mahometan natives of Hindoostan, and subjects of Great Britain. They told me they also knew what the countersign was, having learnt the meaning of it in Persia. Their corps de garde they established without any ceremony on the roof of a neighbouring house; and walked over all the adjoining roofs, and through the families of the occupants, whenever it suited them. To have remonstrated against this abominable tyranny would have been fruitless, nor would the motive have been understood, either by the offenders or sufferers—to so low a degree is the human species debased by a long course of savage oppression. Aga Minas to-day happened to ask one of the police-officers in attendance if some sort of a bedstead could not be procured? "Certainly," said the man; and, without more ado, he went to the first khan, and seized three bedsteads belonging to Bagdad merchants, who happened to lodge there. He brought them in triumph to the house. It is needless to say that the bedsteads were immediately returned to their owners."

Here our limited space compels us to conclude for the present.

Art. IV.—Notes on Persia, Tartary, and Afghanistan. By LIEUT. COL. MONTEITH, K. L. S. *of the Madras Engineers.—Madras Journal of Literature and Science*, 1836.

Defence of British India from Russian Invasion. By CAPTAIN C. F. HEAD, *Queen's Royal Regiment.*

(Continued from page 574.*)*

It appears that the Court of St. Petersburgh have directed their attention to an approach to India without touching on the territory of Persia; but through nations whose arms could be turned against the latter if the policy of the northern autocrat should adopt such a course of proceeding; and Capt. Head shows that any attempt of an European power to oppose the designs of Russia, by a movement in the west of Persia, would be totally useless. The whole weight of such opposition, it is obvious, should be made on the banks of the Indus.

"But if the independence and disposition of Persia were such as to promise, in conjunction with a European nation, to assume a strength likely to put at defiance a combined attack of Russians and Tartars, the reasoning would be otherwise. More attention would be due to this subject if Russia did not command the means that have been pointed out of an advance to India through Khorassan, and which route will be seen to be equally, if not more practicable, as also, under existing circumstances, it appears the most desirable. There may, however, be advantages in the eastern routes that will render them the most advantageous when the localities of the districts they pass through become better known. The Russian government may be presumed to be in possession of the necessary details on which to determine the best line of advance, and enough has been divulged by their officers to create much speculation, and to demand investigation on this point.

Envoys were despatched from St. Petersburgh to the principal towns on the river Oxus, and the reports published of them have been ably discussed by a military author,* and by others in this country. From the Russian authorities the few hints that have been thrown out tend greatly to illustrate this inquiry, and there is here added such information as must shew how desirable it is to be better informed on the resources the Russians would have at command, should they attempt, by pursuing the course of the Oxus river, to pass from their frontier to the Indus. History points out the propensity at all times inherent in the demi-savage nations of Tartary to overrun and plunder their less powerful neighbours. And it will be evident that the tide of prejudice and superior enterprise would in this instance flow with Russia from the north, towards the less warlike inhabitants of Hindoostan.

Should it be determined to prosecute an advance to India by this line of route, a landing would be effected on the eastern side of the Caspian Sea, where there are harbours now in use for merchants trading by caravans with the nation occupying the territory bordering on the Oxus river. The Tartar havens best suited to this purpose are those of Mangushlac Bay, and Balkan Bay, either of which are within a week's sail of Astracan. Mangushlac is the one that affords the most secure harbour, and is generally preferred.*

It has already been mentioned that a Russian force may be brought into the Caspian Sea by means of the Volga river; it will also be found that a force may be detached from Orenburgh, which city carries on a considerable trade with the Turkomans, who inhabit the country lying between the Caspian and the Oxus. At Orenburgh there is a garrison of 10 or 15,000 men, and that city communicates by means of the Oral river with the Caspian, from whence it is distant about 300 miles. At either of the specified havens a force would assemble and prepare for further operations in the direction of the Oxus. The country to be crossed over is included in the province of Khaurizm. It is that already named as lying to the north of Khorassan, and inhabited by tribes of Turkomans. They are not united, or strong enough to become formidable, but possess a predatory disposition, that causes them to be considered troublesome neighbours. These tribes are often at war with each other, and acknowledge no power but that of a patriarchal chief, whose territory comprises steppes and meadows, covered with prodigious droves of cattle which belong to his clan."

"A high authority, whom we have frequently quoted, remarks on the inhabitants of this country. "Although the hostility of these barbarians was a serious evil to the districts which they visited, they had no collective strength that could render them formidable as an enemy to Persia."† The situation, the importance, and even the name of these tribes, often change, and prevent any estimate being formed of their real strength; about 60,000 families of the Kirgees hordes swear fidelity to the Emperor of Russia.

If a Russian force assembled at one of the harbours on the east side of the Caspian, and thereby threatened the kingdom of Khaurizm on the south, while a demonstration to the same effect was made from Orenburgh and the Russian territory that borders

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* Colonel De Lacy Evans.

* Coxe's Travels in Russia.

† Sir John Malcolm.

the country on the north, there can be little doubt but the people who occupy the intermediate space will be disposed to unite in designs so perfectly in accordance with their restless spirit. A force would at once be collected from among them to form an advance guard, and collect other adventurers for a crusade against the idols of Hindoostan. It is therefore presumed that the Russians will find allies, and have the territorial resources at their disposal. Abundance of carriage animals would thus be supplied for the purpose of transport across the desert which intervenes between the Caspian Sea, and Khiva on the border of the Oxus, or Amu river, and the next place of rendezvous for the army. Pallas, an intelligent traveller, was informed that some individuals of the middle horde of Kirgees had 10,000 horses, 300 camels, 300 or 400 sheep, and more than 2000 goats.

The city of Khiva bears the name of a district, containing about 300,000 inhabitants, and stands in a cultivated space or oasis, about 100 miles square. This section of country is watered by canals from the Oxus, and is highly productive. The Russian envoy* who visited it by the route from Balkan Bay in 1819, reports, that he considers the road between the Caspian and Khiva quite practicable, and that the latter place may be occupied without difficulty."

"The route from the Bay of Balkan to Khiva goes over a country but scantily supplied with water, and the march was made by the Russian mission in the month of December; the time occupied was sixteen days by caravan. They did not proceed more than twenty miles a day, but the regular march of trading caravans may be estimated at twelve or fourteen hours' travelling, or at thirty or thirty-six miles per day. The distance from Mangushlac Bay to Khiva may be one-third more than from the Bay of Balkan to the latter place. Mr. Fraser says of the route,† (from Mangushlac to Khiva), "five different persons, well acquainted with the country and trade, agreed in estimating it to me at about ten days' journey of six farsangs each, or about 240 miles."—"The country is inhabited by tribes of wandering Toorkomans, who pasture their flocks upon the steppes, and caravans continually pass and repass between Khiva and Mangushlac Bay."‡

A Russian force, marching by either of the above routes from the borders of the Caspian, would reach the Oxus in less time than a month, and it will be admitted, that, with proper arrangements, there is nothing in the performance of this march by detachments of troops to render it impracticable, when it is considered that carriage animals may be procured to any required extent.

On reaching Khiva, the army would have water communication with the Oxus, which passes fifteen miles from the city, and by means of that river, intercourse would be opened with fertile countries that lie on its banks, and also with the sea of Aral, into which the Oxus empties itself about 150 miles below Khiva. The traveller, from whom we have so often quoted in treating of the district of Khorassan, offers some remarks on the report of the Russian envoy, and thinks a force might not only capture, but retain Khiva. He says, "The Russians have long entertained commercial relations with Khiva, which they have sought to strengthen in various ways, and with various objects. The conquest of Khiva by the Russians would, if they were to resolve on it, be an affair of no serious difficulty; and, according to the present line of policy, the attempt will probably be made at no very remote period."*

The performance of this march deserves every consideration, as will be seen when the remaining part of the route is investigated. If a Russian force should establish itself at Khiva, they would be enabled to pursue their further operations with the advantage of water carriage for the greatest portion of the way to India. On the sea of Aral, "there are numerous large fishing boats employed by the natives."† It does not appear from any account we can find of this territory what facility there may be of opening a communication to make these boats applicable to the operations under consideration. Boats and rafts are used on the Oxus for the purposes of traffic; and it is mentioned by travellers, whom we shall hereafter quote, that wood may be had on parts of this river. A want of correct information on these important points must render the enquiry into this route one of much doubt, and prevents the possibility of our coming to a satisfactory conclusion as to its accomplishment in a definite time. Like the Indus, and other rivers that have their source in high mountains, the Oxus must have a considerable current. Its navigation is said to be carried on by tracking; but it must vary at all seasons, and be liable to the uncertainty that has been stated to govern the progress of boats on the Nile."

"Balkh lies on the north side of the range of mountains that divides Tartary from Hindoostan. The time taken to perform the voyage from Bokhara to this place is said to be five days, making the voyage from Khiva to Balkh to be altogether one of thirteen days. It has already been remarked that the distance by the river is but imperfectly known, but it is not likely to exceed a line of 700 miles, which, at the rate of advance that has been set down for an army, would take about two months.

Before we leave the banks of the Oxus, it will be proper to observe that the imperfect knowledge we have of that stream, in all probability, leads to our selection of a route far less advantageous than some other that

* Captain Mouravief.
† Journey into Khorassan, by J. B. Fraser.
‡ Ibid.

* Journey into Khorrassan, by J. B. Fraser.
† Evans.

might become obvious with a better acquaintance of the country. There is a branch of the Oxus running from opposite Bokhara towards Herat; and in the same direction there is said to be a practicable road between those places of about 600 miles, through a fertile and watered country. This uncertainty obliges us in this enquiry to follow the line of march in constant use by caravans, and proceeding through Balkh in progress towards the Indus.

The town of Balkh is situated about thirty miles from the point where the Oxus is navigable; and it will be necessary to examine the capabilities of this province, where the army would be obliged to abandon their water carriage, and have recourse to baggage animals."

(To be continued.)

Art. V.—On the production of silk at Kamptee. By Miss Anna Calder, *with* Mr. Prinsep's *Report on the specimens forwarded.*

Raw Silk, from a printed copy forwarded to the Agricultural Society of India. By George Norton, *of Madras.*

Experimental cultivation in Western India.

Extract of a Letter from Mr. Shakespear, *on an improved method in winding silk.*

On the Silks of Assam. By Captain Jenkins.—*Trans. Agricultural and Horticultural Society,* 1836.

Remarks on the Silk Worms and Silks of Assam. By Mr. Thomas Hugon, *Sub. Asst. Nowgong.—Journal of the Asiatic Society, for January,* 1837.

(*Continued from page* 567.)

We are able to give additional valuable information from the following valuable papers by Mr. Hugon.

The following worms producing silk are found in *Assam.* The mulberry worm (large and small), the *eria*, the *mooga*, or *moonga*, the *kontkuri*, the *deo mooga*, and the *haumpottonee.* The five last are indigenous to the country, but there is no reason to suppose that the first is likewise so. The mulberry is scarce, and none is found in the wild state. The time of the introduction could be, perhaps, ascertained in some of the Assamese *booronjees* or chronicles—(which Mr. Hugon was unable to procure immediately to ascertain the point); some of them extending several centuries back—as the Assamese got religious instructors from *Bengal*, it is very probable they also got from there the mulberry tree and worm. The use of the silk being confined to the rája and grandees, and the rearing of the worm to but one caste, are additional proofs that its introduction did not precede that of Hinduism.

"MULBERRY WORM.—The management of these worms in *Assam* is nearly similar to what it is in *Bengal.* They are reared within doors, and require the same care and attention as are bestowed on them there; a separate hut is used, which is fitted with bamboo stages with a passage between them and the outer wall—these huts are built north and south with a single door on the east side. This is generally the case, but by no means a fixed rule amongst the Assamese. Only one female of the family goes into the house, and previous to doing it always washes her hands and feet. The large and small mulberry worms are reared in *Assam.* The rearing of those which produce only one bund a year, are described (the larger), they being more in use than the others in this district. The moths are made to deposit their eggs on pieces of cloth—these are packed up with the household clothing; when the time of hatching approaches (December), they are taken out and exposed to the air. On being hatched the worms are fed the first three or four days on the tender leaves cut up, in new earthen pots; then on a bamboo tray. After the first moulting they are removed to the *mutchang* (*machán*) or stages. When they are about beginning to spin, they are put on bamboo trays fitted up with pieces of matting fixed perpendicularly at intervals of two inches: these in the first afternoon are exposed for half an hour to the side where the sun is shining, and afterwards hung up in the house. After leaving as many as are required for breeding, those

that are to be wound off, after having been exposed to the sun for three or four days, are put over a slow fire in an earthen vase full of water. One person winds off the silk with an instrument made of three pieces of stick joined together thus: the perpendi-

cular one is held at one end with the right hand, and the left directs the thread over the cross bars; taking care in doing this to make it rub against the fore-arm to twist it, whilst another person attends to the fire and the putting on new cocoons. When a sufficient quantity for a skein has thus accumulated it is taken off the cross bars."

"It appears there are not many plantations of mulberry in *Assam*, on such a scale as to be worth mentioning; a few men of rank have small patches of it, sufficient to produce silk for their own use;—the few ryuts that sell the silk generally have not more than a seer to dispose of in the year,—the produce of a few plants round their huts or in the hedges of their fields. The leaves are not sold as in *Bengal*, and when a ryut's own supply fails, he obtains it from neighbours who have a few trees merely for the fruit. The worms are reared by *joogees* alone, people of an inferior caste: those of the highest can cultivate the plant and do all the out-of-door work; but none but a *joogee* can, without degradation, attend to the worms or touch the silk whilst reeling. These prejudices do not exist in *Bengal*."

" Mr. SCOTT, a few years ago, introduced from *Rungpoor*, reelers, reels and plants of the *morus alba*, and established a factory at *Darang*, with a view to extend the culture of mulberry silk, and improve the reeling of the *mooga*. Several causes rendered the experiment abortive, the want of European superintendence and Mr. SCOTT's untimely death being the principal ones*.

ERIA SILK.—The *eria* worm and moth differ from the mulberry worm and moth in every respect, as will be better understood by the accompanying drawings and insects (plate IX:) like it, however, it goes through four different moultings, but its sickness in doing it lasts only twenty-four hours; the last stage takes eight days, the others four. The duration of its life varies according to seasons: in summer it is shorter, and the produce both greater and better; at this season, from its birth to the time it begins its cocoon, twenty to twenty-four days expire, in fifteen more the moth comes forth, the eggs are laid in three days, and in five they are hatched, making the total duration of a breed forty-three to forty-seven days: in winter it is nearly two months; the number of breeds in the year are reckoned at seven.

This worm is, like the mulberry worm, reared entirely within doors: it is fed principally on the *hera* or palma christi leaves; it eats the mulberry leaf also but is said to prefer the former: when the palma-christi leaves fail, they are also fed on those of several other trees known in this part of *Assam* by the following names:—

1. Kossool.
2. Hindoo gass.
3. Meekeerdal.
4. Okonnee
5. Gomarree.
6. Litta Pakoree.
7. Borzonolly.

The worms thrive best and produce most when entirely fed on the palma-christi: it is the only plant which is cultivated purposely for it, there is hardly one ryut who has not a small patch of it near his house or on the hedges of his fields; it requires little or no culture. The ground is turned up a little with the hoe and the seeds thrown in without ploughing; whilst the plant is young it is weeded once or twice, but it is afterwards left to itself. The plant is renewed every three years. On the leaves of Nos. 1 and 2, worms can be reared entirely, but they do not thrive well upon it; many die even after having begun the cocoons, and the few of these that are got are small and yield but little. These and the others are only used in the fourth or fifth stage, when they are considered to answer quite as well as the palma-christi leaves. The *kossool* (No. 1) alone can be given alternately with the palma-christi. The whole of these trees are found in the forests, but not cultivated.

To breed from, the Assamese select cocoons from those which have been begun in the largest number on the same day—generally the second or third day after cocoons have begun to be formed; those that contain males being distinguished by a more pointed end. These cocoons are put in a closed basket and hung up in the house out of the reach of rats and insects. When the moths come forth they are allowed to move about in the basket for twenty-four hours; after which the females (known only by the larger body) are tied to long reeds or canes, twenty or

* From the opinions given by several merchants of *Calcutta* on samples of *Assam* mulberry silk, reeled on Italian reels from worms properly fed and attended to, I am led to believe this province exceedingly favorable to the production of very superior silk.—The samples sent down would have fetched the highest prices in the Calcutta market, and they were got up under the unfavorable circumstances of a rude experiment.—F. JENKINS.

twenty five to each, and these are hung up in the house. The eggs that have been laid the first three days amounting to about two hundred are alone kept, they are tied in a piece of cloth and suspended to the roof until a few begin to hatch ; these eggs are white, and of the size of turnip seed : when a few of the worms are hatched, the cloths are put on small bamboo platters hung up in the house, in which they are fed with tender leaves ; after the second moulting they are removed to bunches of leaves suspended above the ground, under them upon the ground a mat is laid to receive them when they fall ; when they have ceased feeding they are thrown into baskets full of dry leaves, amongst which they form their cocoons. two or three being often found joined together.

Tne caterpillar is at first about a quarter of an inch in length, and appears nearly black ; as it increases in size it becomes of an orange colour, with six black spots on each of the twelve rings which form its body. The head, claws, and holders are black ; after the second moulting they change to an orange colour : that of the body gradually becomes lighter ; in some approaching to white, in others to green, and the black spots gradually become the colour of the body. After the fourth and last moulting the colour is a dirty white or a dark green : the white caterpillars invariably spin red silk, the green ones white. On attaining its full size the worm is about three and half inches long : unlike the *mooga* caterpillar, its colours are uniform and dull : the breathing holes are marked by a black mark : the moles have become the colour of the body; they have increased to long fleshy points, without the sharp prickles the *Mooga* worm has. The body has a few short hairs, hardly perceptible.

In four days the cocoons are complete ; after the selection for the next breed is made, they are exposed to the sun for two or three days to destroy the vitality of the chrysalis. The hill tribes settled in the plains are very fond of eating the chrysalis : they perforate the cocoons the third day to get them ; they do the same with the *mooga* and sell few cocoons imperforated.

The cocoons are put over a slow fire in a solution of potash, when the silk comes easily off : they are taken out and the water slightly pressed out ; they are then taken one by one, loosened at one end, and the cocoon put over the thumb of the left hand. With the right they draw it out nearly the thickness of twine, reducing any inequality by rubbing it between the index and thumb : in this way new cocoons are joined on. The thread is allowed to accumulate in heaps of a quarter of a seer, and is afterwards exposed to the sun or near the fire to dry ; it is then made into skeins with two sticks tied at one end and opening like a pair of compasses : it is then ready to be wove unless it has to be dyed.

The dyes used are lac, munjeet, and indigo, and the process of dyeing is as follows.

RED DYE.—The lac, after having been exposed to the sun to render it brittle, is gronnd and sieved as fine as possible : it is steeped twelve hours in water, after which the thread is thrown in with the leaves of a tree, called by the Assamese *Litakoo* (—*Pierardia sapida ?* F. J.) When it has absorbed most of this mixture, it is taken out, put over two cross sticks, and shaken a short time, to detach the threads well from each other : it is dried in the sun and the same process again gone through twice. When it is wished to increase the brightness of the colour, it is again dyed with munjeet : the latter is dried in the sun and ground in the same way ; it is steeped for forty-eight hours. The threads are put in and boiled in the same way, but with the leaves of a different tree (the *Koh*) : the thread is dried in the sun, and is ready for use. Nearly the same process is gone through for the blue : instead of the common indigo, they sometimes use the *Room*, which plant is, I believe, *Ruellia callosa ;* also the leaves of a very large tree found in the forests, called by them *Ooriam*. The thread is wove as cotton. The different prices of the cloths and their use will be found in an annexed table : their clothes are mostly used for house consumption ; a few are bartered with the Bhotias and other hill tribes. Large quantities were formerly exported to *Lassa* by merchants, known in *Derung* as the " Kampa Bhotias."

" MOOGA SILK.—Although the *mooga* moth can be reared in houses, it is fed and thrives best in the open air and on the trees. The trees which afford it food are known in *Assam* by the following names :—

1. Addakoory.
2. Champa, (*Michelia*.)
3. Soom.
4. Kontooloa.
5. Digluttee, (*Tetranthera diglottica*, HAM.)
6. Patteeshoonda, (*Laurus obtusifolia*, " ROXB.")
7. Sonhalloo, (*Tetranthera macrophylla*, " ROXB.")

SILK FROM No. 1. ADDAKOORY.—The Addakoory, the worms fed on which, produce the *Mazankoory mooga*, is a middle-sized tree, used for rearing worms only when under four years. It sprouts up where forests have been cleared up for the cultivation of rice or cotton. The worms that are put on the tree on the first year of their appearance above the ground produce the best silk. The second year the crops are inferior in quality and quantity, and the third it is little if at all superior to the common *mooga*. The *Mazankoory* silk is nearly white, and its value fifty per cent, above that of the common fawn-colored.

The tending of the worms on this tree is much more laborious than on any of the others : young trees only being used, they

have to be constantly removed to fresh ones; the smoothness of the bark also renders it necessary to help them in moving from branch to branch. This tree is more abundant in *Upper* than in *Lower Assam*: last year it was for the first time found to exist in the forests of the *Morung*, on the eastern boundary of this district. The Upper Assamese, who are settled throughout this district (they form one-fourth or one-fifth of our population here), have never met with it in any other place.

No. 2. CHAMPA.—The Champa is found, as the Addakoory, where forests have been cleared: the silk of the worms fed on it is called "*Champa pootia mooga*." It is held in the same estimation as the "*Mazankoory*;" I do not know whether it is also used when young: the tree is not met with in *Lower Assam*.

No. 3. SOOM is found principally in the forests of the plains and in the villages, where the plantations of this tree are very extensive. It attains a large size and yields three crops of leaves in the year: the silk produced by it is of a light fawn colour, and estimated next to the *Mazankoory:* the plantations are most abundant in the eastern half of this district.

No. 4. KONTOOLOA.—This is a large tree found both in the hills and the plains; also a few in the villages: the leaves are too hard for young worms, which are reared on the preceding (No. 3), till the third moulting, and then put on this tree; by which process the silk obtained is stronger than that from worms reared entirely on the Soom.

No. 5. DIGLUTTEE.—A tree of a small size not much used on that account: the silk equal to that obtained from No. 3.

No. 6. PATTEE SHOONDA.—Middle-sized trees, found principally in forests; few to be met with in the villages of *Lower Assam*; used when the leaves of No. 3 are done.

No. 7. SONHALLOO.—The Sonhalloo is found in the forests of the hills and plains, where it attains a very large size: it is also found in the villages, where in six years it attains its full growth (thirty feet); it is very abundant in the western portion of this district, *Rora*, *Jamna*, *Mookh*, *Jyntea*, and the valley of *Dhurmpoor*. At the latter place, where the hill tribes of *Mikirs* and *Kacharis* clear dense forests, for the cultivation of rice and cotton, numbers of the plants spring up spontaneously. After three or four years, when the land getting poorer requires more tillage and the use of the plough, these tribes who only use the *kar*, or hoe, remove to new forests, and leave behind them plantations of these trees, which they have used during the short period they have remained. To them the ryuts of the more settled parts resort in the spring to rear up worms. The silk of the Sonhalloo-fed worm is considered inferior to the preceding; more I believe from its darker colour than any other cause.

There are generally five breeds of *mooga* worms in the year: they are named after the months at which they generally occur.

1. *Jarooa*, in January and February.
2. *Jeytooa*, in May and June.
3. *Aharooa*, in June and July.
4. *Bhodia*, in August and September.
5. *Khotia*, in October and November.

The first and last are the best crops as to quality and quantity. Nos. 3 and 4 yield so little and so inferior a silk, that they may be said to be merely for the purpose of continuing the breed. Were the Assamese acquainted with the process of retarding the hatching of the eggs as is practised in *China*, in regard to the mulbery silk-worm, they would, I think, find it more advantageous to have only three or four crops.

The same rule is followed in the selection of cocoons to breed from, as in the *Eria*. They are put in a closed basket suspended from the roof: the moths as they come forth having room to move about after a day, the females (known only by their larger body) are taken out and tied to small wisps of thatching grass, taken always from over the hearth; its darkened colour being thought more acceptable to the moth. If out of a batch there should be but few males, the wisps with the females tied to them are exposed outside at night: the males thrown away in the neighbourhood find their way to them. These wisps are hung on a string tied across the house to keep them from the lizards and rats. The eggs laid during the first three days (about 250) are the only ones thought worth the keeping: those laid on the two or three subsequent days are said to produce weak worms. The wisps are taken out morning and evening, and exposed to the side where the sun is shining: ten days after the laying of the eggs, a few of them are hatched; the wisps are then hung up to the tree, the young worms finding their way to the leaves: care must be taken that the ants have been destroyed, their bite proving fatal to the worm in its early stages. To effect this they rub the trunk of the tree with molasses, and tie to it fish and dead toads. When large numbers have been attracted to one place they destroy them with fire: this they do several times previously to the worms being put on. The ground under the trees must be kept clear of jungle to make it easy to find the worms that fall down: young trees are preferable until the second moulting.

To prevent the worms coming to the ground, fresh plantain leaves are tied round the trunk, over the slippery surface of which they cannot crawl. They are removed to fresh trees on bamboo platters tied to long poles.

Bats, owls, rats, are very destructive at night: in the day the worms require to be constantly watched; crows and other birds being so fond of them, that they lie in wait in the neighbouring trees. An old lady's doze over her morning "canee" (opium,)

however short, is sure to be fatal to several worms: the *goolail* which is always at hand often punishes the thief; but the mischief is done.

Numbers are destroyed in the more advanced stages by the sting of wasps, and by the ichneumon insect, which deposits its eggs in their body. These are hatched when the cocoon is half formed: they perforate it at the side and the chrysalis is found dead: the worms which have thus been stung are known by black marks on their body. Were the people more careful in their management, this would be of little consequence: by making these worms spin apart, the cocoon being formed before the chrysalis is killed, the silk could be saved.

The worms thrive best in dry weather: but a very hot sunny day proves fatal to many at the time of moulting. At these periods rain is very favorable: thunder storms do not injure them as they do the mulberry worm; continual heavy-rains (which are rarer in *Assam* than in *Bengal*) are hurtful by throwing them down: showers, however heavy, cause no great damage, they taking shelter under the leaves with perfect safety. The worms during their moultings remain on the branches, but when about beginning to spin they come down the trunk; the plaintain leaves preventing their going further down, they are collected in baskets, which are afterwards put under bunches of dry leaves suspended from the roof: they crawl up into these and form their cocoons; as with the *Eria*, several are often joined together. The silk of these they spin instead of winding: above the plantain leaf a roll of grass is tied for those that come down during the night to begin spinning in. After four days the selection of cocoons for the next breed is made and the rest wound off.

The total duration of a breed varies from sixty to seventy days. The period is thus divided; four moultings, with one day's illness attending each, ... 20

From fourth moulting to beginning of cocoon, ...	10
In the cocoon, ...	20
As a moth, ...	6
Hatching of the eggs, ...	10
	—
	66

On being hatched the worm is about a quarter of an inch long; it appears composed of alternate black and yellow rings: as it increases in size the former are distinguished, as six black moles, in regular lines on each of the twelve rings which form its body. The colours gradually alter as it progresses; that of the body becoming lighter, the moles sky-blue, then red, with a bright gold-colored ring round each. When full grown, the worm is above four inches long; its colours are most brilliant and varied in shades; the body appears transparent, and is of a very light yellow or dark green colour, with a brown and yellow streak at the sides; in the latter the breathing holes are distinguished by a black speck. The moles are red and have each four sharp prickles and a few black hairs; the head and claws are of a light brown, the holders green, and covered with short black hair; the last pair have a black ring on the outside. On being tapped with the finger the body renders a hollow sound; by the sound it is acertained whether they have come down for want of leaves on the tree, or from their having ceased feeding.

The chrysalis not being soon killed by exposure to the sun, when they have many cocoons they put them on stages, cover them up with leaves, and burn grass under them: the cocoons are then boiled for about an hour in a solution of the potash made from the dried stalks of rice; they are then taken out and laid on cloth folded over to keep them warm: from this they are taken as required, and thrown in hot water (not over the fire) after the floss has been removed with the hand. The instrument used for winding off the silk is the coarsest imaginable. A thick bamboo about three feet long is split in two, and the pieces driven equally in the ground two feet apart; over the interior projection of one of the knots is laid a stick, to which is fixed, a little on one side, a round piece of blank about one foot in diameter. The rotary motion is given by jerking this axle, on which the thread rolls itself: in front of the vessel holding the cocoons a stick is fixed horizontally for the thread to travel upon. Two persons are employed: one attending the cocoons; the other jerks the axle with the right hand, and with the same hand directs the thread up the left forearm, so that it is twisted in coming down again towards the hand; the left hand directs the thread over the axle. Fifteen cocoons is the smallest number they can wind off in one thread, twenty the number generally; even the last is often broken from the coarseness of the instrument used, although the fibre is much stouter than that of the mulberry silk. When nearly a quarter of a seer has accumulated on the axle, it is dried in the sun and made into skeins of one or two rupees weight. This is done with a small bamboo frame set in motion by the common spinning machine of the country: if it has to be dyed, the same process is followed as with the *Eria*. The cloths are usually made of *mooga*, and their use will be found in the annexed table: besides those, I have seen it used as the warp with cotton, and the cloth so made is a little lighter colour than nankin and much stronger; but this is seldom done, from the trouble of spinning the cotton fine enough. Cotton twist adapted to that purpose would, I think, meet a ready market.

The exact quantity of silk, which an acre of *mooga* trees can produce, could not be ascertained without a trial. Fifty thousand cocoons per acre*, which makes upwards of

* An Assamese Poorah of land is a little more than an English statute acre, and such lands hitherto have not been taxed, or at a very low rate, if cultivated with other crops besides the *mooga*.

twelve seers, are considered by the Assamese a good yearly return. Sixty rupees, the value of twelve seers, must be a very profitable one, for there is little labor or expense to the ryut in making or keeping up a plantation : whilst the trees are young, the ground is available for cultivation, besides rearing worms; sugarcane, rice, pulse, &c. are cultivated with benefit rather than injury to the young trees. The tax is fourteen annas the acre in this district. The great value of the *mooga* is, that it enables the weaker members of a family to contribute as much as the most robust to the welfare of the whole. Besides attending to the worms, most of them weave, spin, or make baskets, while watching them.

From causes which I have been unable to ascertain, and of which the natives are ignorant, the *mooga* some years failed so completely in particular districts, that none was left to continue the breed. There being very few *hauts* or markets to resort to, to procure cocoons for breeding from the more fortunate people of other districts, a failure of this kind in one place is sensibly felt for two or three years after in the production. The time of the ryut, who has at most half or a quarter of an acre of *mooga* trees, is too valuable to allow of his being absent for a month and more, going from village to village, and house to house, to find out the people who have cocoons for sale. This last season in our *Jumna múkh* (*Cachar*) pergunnah the *mooga* was a complete failure ; there are no worms on the trees now, from inability to procure cocoons, although there was a very abundant crop in two pergunnahs at the opposite end of the district.

The *mooga* plantations are principally round the ryuts' houses, and are included in house-lands. By this year's measurement of the Barree lands in the three divisions of the *Nowgong* zillah, where the land tax obtains, the quantity in actual occupation (exclusive of those which being unclaimed have reverted to the state) amounts to 5350 acres : the proportion of *mooga* plantations is upwards of one-fourth or 1337 acres. In the five other divisions of the same zillah, which are three times the area, and have more than double the population, but of which we have no accurate measurements, I will only venture to estimate the quantity of *mooga* plantations, at half that of the other three, or about 600 acres, but on this low calculation there would be a total of 2000 acres for *Nowgong*. Estimating the plantations of the *Derung* and *Kamrúp* zillahs at only 1500 acres each, there would be a total of 5000 acres of those plantations in *Lower Assam*, exclusive of what the forests contain of them : this quantity is capable of producing in one year 1500 maunds. In *Upper Assam* I understand the plantations are more extensive than ours.

4. KONTKURI MOOGA.—This worm feeds on many trees besides the "*mooga* trees;" it is found oftener on the *bair* (*Zizyphus jujuba*) and the *seemul* (*Bombax heptaphyllum*), but not in great quantities. The worms, moths, and cocoons are considerably larger than any of the others ; indeed the cocoon is the size of a fowl's egg. Several Assamese told me they had vainly attempted to domesticate them ; the eggs have been hatched, but after observing the worms for a few days on the trees they have at once disappeared. They attributed this to its being a "dewang," or spirit; the real cause may probably be its being fond of changing its food, and gifted with greater locomotive powers than the generality of the silk-worms. I have been told by some Bengalees that it is found in *Bengal* in the wild state on the "bair" as in *Assam*, and called "Gootee-poka;" it is there reeled off like the mulberry silk, and much valued for fishing lines, but not wove, probably from its scarcity. The fibre is stronger than that of the *mooga* and of a lighter colour.

5. DEO MOOGA.—I accidentally became acquainted with this worm, which is very little known to the natives, and entirely in the wild state. Three years ago being employed in *Jumna-múkh* (*Cachar*), I had occasion to take some bearings, for which purpose I had a white cloth put up on a large "bur" tree (*Ficus Indica*). The year after, being near the spot, the ryuts came and told me that two months after I left (April), they observed that the tree had lost all its foliage ; they went to it and found in the surrounding grass and dry leaves a large number of small cocoons : these they spun like the *eria* out of curiosity and used it with the latter. They took no further notice of succeeding breeds, finding the thing of little present use. I lost a few cocoons which I procured at the time, but have lately seen both the worm and the cocoon : the former is quite different from any other ; it is more active, its length is under $2\frac{1}{2}$ inches, the body very slender in proportion to its length, the colour reddish and glazed. I could not observe them more particularly, as they were brought to me one evening at dusk : I put them in a box, with the intention of examining them the next morning, but they disappeared during the night, although it was open very little to admit the air. The moth is very much like that of the mulberry, so is the cocoon also in appearance, colour, and size : I have questioned many of the natives about this worm, but none had ever seen it before ; their opinion of it is that it is a "dewang" (spirit), brought there by the prismater compass and the white flag. This made them call it *deo mooga*.

The *haumpottonee*, a caterpiller very common in *Assam* (and elsewhere perhaps), may also be mentioned as one of the varieties of the species, although it forms but a very imperfect cocoon : it feeds on most leaves. I have had no opportunity yet of observing it myself; but am told by the natives that it goes through similar stages to the others. The worm is about two inches long, of a brown colour, and covered with hair ; the moth of the same colour as the *mooga* moth, but only half


Plate IX
India Review
Cocoon
the Toree Silk moth
Bombyx religiosa
Koongu Silk worm
and moth
1 Stage
3rd Stage
5 Stage
Chrysalis
Fig. 1.
T
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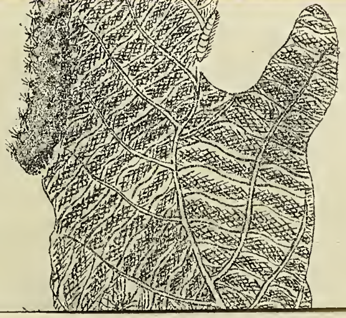
the Eria Silk worm
and moth
5th Stage
Chrysalis
1st Stage
Cocoon
2nd Stage
3rd Stage
Medl. Journl. Press, Fort William.

3^d. Stage



5 Stage

Chrysalis

Med^l. Journ^l. Press, Fort William

the size: the cocoon has this peculiarity, that it is quite transparent, so that the chrysalis can be seen inside. At one end of it a small opening is left: the cocoon is of a yellow colour; it can be spun like the *eria* cocoon, but the Assamese do not use it, on account of its silk causing a severe itching in wearing.

I have questioned several Bengalees settled in *Assam*, and who have been at *Midnapur*, regarding the identity of the *mooga* and *tussur;* they say that the worm is the same, but that at the latter place they are fed on a different tree. The point could be better ascertained by a comparison with the drawings and preserved worms which accompany these remarks. The Burmese envoys who have just left *Assam* told me that the *mooga* was unknown in their country previous to the conquest of *Assam;* but that it had since been introduced by the Assamese who were carried off and settled in the Burmese territory. The *Cacharis* also admit that it is not many years since it was introduced into *Cachar* (south of the hills). In *Cooch Behar*, both it and the *eria* are almost unknown to this day: the prevailing opinion amongst the natives of these parts is, that both species (*mooga* and *eria*) are indigenous to *Upper Assam*, and were introduced from thence. It has always appeared to me that the production of these silks is greater as one advances to the east: it is to this day procurable more abundantly in *Upper Assam* than any where else, especially in the district of *Lukinpoor* on the north bank of the *Burhampootur.*"

"In the within Mr. Hugon has said nothing of another silk worm which was lately discovered on a pipul tree (*F. religiosa)*, and of the moth of which a drawing accompanies, with three or four cocoons, a chrysalis, and two moths. This looks very like the mulberry moth, but I am not able to say whether it is or not. The silk looks very fine, and it may be considered a curiosity, even if it be the produce of a mulberry worm, for the question arises on what was the worm fed?—if on the *F. religiosa*, it is, I believe, a discovery, that the silk worm would feed on the leaf of any tree but the mulberry: if the worm is distinct from the *Bombyx mori*, it is a still greater curiosity.

Mr. Hugon has been unable to determine whether the worm now alluded to, is the same as the *deo mooga* mentioned within: he is inclined to think not, from the colour of the cocoons and the slight observations he was able to make on the latter; but from both feeding on the leaves of two trees so nearly allied, I should suppose it likely that the worms were identical. It would be a discovery of some importance to find worms affording any tolerable silk, that fed on these species of Ficus which are so abundant here. —F. Jenkins."

LIST OF THE CLOTHS MADE IN ASSAM OF MOOGA AND ERIA SILKS.

Names of Cloth.	Size in Cubits.	Weight.		Price of Thread.			Cost of Weaving.			Total.			Remarks.
		Seer.	Chk.	R.	A.	P.	R.	A.	P.	R.	A.	P.	
Mooga.													
Soorias, ...	7 by 1½	0	6	1	14	0	0	3	0	2	1	0	Dhoties.
Ditto, ...	16 ,, 2	1	0	5	0	0	0	8	0	5	8	0	
Mekla	5 ,, 1¾	0	4	1	4	0	0	2	0	1	6	0	Petticoats.
Rhia, ...	12 ,, 1¼	0	8	2	8	0	0	4	0	2	12	0	Scarfs.
Gaurshan, .. .	8 ,, 1	0	2	0	10	0	0	1	0	0	11	0	Worn as turbans, or round the waist.
Joonta Bor Cappor, ...	12 ,, 2½	1	0	2	0	0	0	6	0	2	6	0	Made of the floss & worn in winter.
Eria.													
Bor Cappor ..	16 by 3	1	8	3	0	0	0	8	0	3	8	0	Worn in winter and used as a blanket: also made into coats.
Meklas, ...	5 ,, 2	0	6	0	12	0	0	2	0	0	14	0	Used only by the poorer class.
Rhia, ...	10 ,, 1½	0	8	1	0	0	0	2	0	1	2	0	
Gaursha, ...	8 ,, ½	0	4	0	8	0	0	2	0	0	10	0	

MEMORANDUM UPON THE SPECIMENS OF SILK, AND SILKWORM FROM ASSAM.

By W. Prinsep, Esq.

The *mooga* or *tussur* cocoons are very fine, particularly those fed from the *soom* and the *sohaloo* trees, which are superior to the produce of the jungles about *Bankoora.*

The thread from these worms is quite equal to that which is used in the best *China* tussur cloths.

The specimens of cloth wove from these threads are not equal, however, either to the *Bengal* tussur cloth, or to the *China* cloth of the same description.

The *eria* cocoon, thread, and cloth, are all new to us: I have never seen them in *Bengal*

except now and then a few pieces of the cloth imported from *Rungpur;* it appears to be more cottony than the tussur, and to make a web warmer and softer than the tussur cloth, but it is not so strong.

The cocoons called *haumpottonee* are unknown to us in *Bengal*, and appear to be of small value, both as to quantity and texture: moreover, I imagine it would be very difficult to reel them into thread.

The *deo mooga* cocoons are very small, but are fine and soft, and when fresh would yield, I doubt not, a very delicate white thread: they are smaller than our desee (country) cocoon.

The specimen of country worm silk is very fair, and if dressed would be quite equal to our *Patna* thread, from which korahs and other silk piece goods are made.

The specimen of iron reel (or station method) is very good, indeed, equal to our best native filature letter A: the thread is even, soft, sound, and remarkably strong, so that it may be well ranked with our best second quality from the filatures of Bengal."

ORIGINAL COMMUNICATION.

INDICATION OF A NEW GENUS OF INSESSORES, TENDING TO CONNECT THE SYLVIADÆ AND MUSCICAPIDÆ.

By B. H. Hodgson, Esq.,
Resident in Nepal.

(For the India Review.)

DENTIROSTRES, SYLVIADÆ, SAXICOLINÆ.

Genus Niltava nobis. Niltau of Nepal.

Bill Phœnicornian, equal to the head, stout, subdepressed, conico-subtetragonal. Culmen half carinated, and so far hid by a subsetaceous thick porrect frontal zone concealing the advanced nares. Legs and feet Sylviadan. Tarsi sufficiently elevate, $\frac{1}{3}$ longer than the central toe, smooth, not feeble. Toes compressed, hard, slender, unequal; laterals and hind approaching to equality: fores basally nect, the exterior one as far as the joint: sole flattish but not dilated. Nails slender, largish, acute, simple. Wings medial, round-acuminate, firm; 5th quill longest, 1st and 2nd considerably, 3rd and 4th trivially, and both subequally gradated. Tail medial, firm, even. Caudal and alar plumes finely pointed. Rictus rather wide and bristled; chin and nares furnished with curling hairs.

Habits, forest-haunting, arboreal and terrestrial, but chiefly the former, exploring foliage. Food, various sorts of soft and hard, perfect and imperfect, insects. Bugs, fire-flies, tiny coleoptera, caterpillars, ants, pulpy berries, and hard seeds, the latter chiefly in winter. Solitary. Never seize on wing. Habitat central region of the hills.

1st species and type. Niltava Sundara nobis. Nos. 142,422-3 of the specimens and drawing apud Zoological Society of London.

2nd species. Niltava Fuligiventer nobis. Nos. 143, 714 ut ante.

3rd species. Niltava Brevipes nobis. Nos. 137-8.

Phœnicura Rubeculoïdes of Gould's Century.

1st species. 7 inches long by 10 wide and $\frac{3}{4}$ oz. Bill $\frac{3}{4}$. Tail 3. Tarsus 15-16ths Central toe 9-16ths, Hind. 6-16ths. Closed wing $3\frac{1}{4}$, whereof the 1st quill is $1\frac{5}{8}$, the 2nd $2\frac{5}{8}$, the 3rd 3, 1-16ths, the 4th 3,3-16ths, and the 5th 3,4-16ths. Wings to mid-tail or $1\frac{1}{2}$ inches less its tip.

Colour. Mas. intire cap, spot on either side the neck, shoulders, rump, and caudal plumes externally, brilliant, lilaceous, cœrulean: lores, frontal band, chin, throat, body above, and wings, black; the two last with a vague dark blue gloss or superficial tint: whole body below and lining of the wings, brilliant rusty: bill black, legs plumbeous, iris brown. Female subolive, paler below, and fading to sordid white at the vent; wings and tail externally, chesnut brown; frontal zone, ochreous; cheeks and chin, shaded with the same: white gorget on the top of the breast; blue neck spot as in male, margining the gorget on its superior lateral edge. Sexes of equal size. Young at first like the female, but wanting the gorget and neck spot; chin greyish; neck, breast, and sides gradually suffused with ferruginous.

2nd species. $5\frac{1}{2}$ inches long by 8 wide; $\frac{1}{3}$ oz. Bill 9-16ths. Tail $2\frac{1}{4}$. Tarsus 13-16ths. Central toe 8-16ths. Hind, 5-16ths. Bill shorter and less armed at the point than in the type: frontal zone more produced: lateral toes less equal.

Colour. Mas. above with the head and neck purpurescent dark blue, paler and richer on the shoulders and rump: lores and frontal band black, and margined above by lilaceous cerulean, which also forms a spot on the neck, as in the last: alar and caudal plumes internally black: breast dusky, fading into sordid white lower down: lining of wings, white: bill black: legs fleshy brown: iris dark. Bill shorter than the head and more than half concealed by the frontal plumes. Female, as in Sundara; but the white gorget on the breast of the latter transferred in this to the chin and front of neck, which are white, with a black margin proceeding from the gape: no blue spot on neck: bill dusky horn: legs fleshy grey. Young like female.

3rd species. Brevipes. Less typical than either of the foregone. Distinguished for the shortness of its tarsi, hardly exceeding the elevation in Muscicapa. Bill equal to the head, rather more cylindric than in the type, and having the frontal band more restricted but still concealing the nares. The lateral and hind toes are distinctly unequal, and the feet similar to those of Muscicapa Melanops. Size, 6 inches long by 9 wide, and $\frac{1}{2}$ oz. in weight. Bill 11-16ths. Tail $2\frac{1}{2}$. Tarsus 11-16ths. Central toe 8-16ths. Hind 5-16ths.

Colour. Mas. above, with the head and neck, dark blue, as in the last, but not purpurescent. Lores and frontal band, black as before, and similarly margined above by a cerulean zone. Wings and tail internally black: bottom of neck, breast, and flanks rusty: lining of wings, paler: rest of body below, white: shoulders and rump hardly more brilliant than the general hue: no spot on neck: bill black: legs bluish, fleshy grey: iris dark. Female, above, subolive, passing into chesnut on the wings and tail, as in both the precedent: lores, front, cheek, neck below, breast, and flanks, rusty like the breast and flanks of the male; the rest of the body below, white as in him: bill dusky horn; legs and iris, as in male. Young, at first, like female, but with the upper parts blotched with buff; bill brown and legs white. In youngish males, the flanks are white like the belly, and the chin and throat black, wanting the blue supratint of maturity. In this state, Gould has figured the bird. The whole cap is not light blue, but only a zone round the brows from behind the eyes.

Remarks.—From the uniformity of colouring in these three species, it seems probable that the peculiar tints of both sexes are generically significant. The general structure, like the habits, seems borrowed equally from the Muscicapidæ and Sylviadæ. In the type or Sundara, the strength and form of the bill are quite Phœnicornian, with a slight leaning towards Saxicola, to which genus this bird is most closely allied by the structure of its feet; as also to Sylvia as typed by Hippolais, the Reed wren, and the Grasshopper Warbler. In fact, the diagnosis of the genus is the union of Sylviadan feet with a Muscicapidan bill, and the manners expressly pourtray this osculant character and position. These birds are as much more terrestrial than the typical Flycatchers as they are less so than the typical Warblers, but taking structure and habits together, I conceive their affinities to lie with the latter family; their analogies with the former. There is a gradation of characters both in the bills and feet leading from Niltava to the next form or Siphia which, for the present, I propose to consider a subgenus of Niltava, though I deem it very possible that our Siphia Strophiata may prove to be the type of the genus, as exhibiting the fullest development of the Flycatcher bill with the Sylvian feet. I confess some surprise that any person having access to the Libraries and Museums of Europe should have ranged our third species of Niltava under the genus Phœnicura, an eminently terrestrial group approaching to Motacilla and consequently almost antipodal to Muscicapa. Mr. Gould's specimen was a young bird evidently, from his description of its colours; and perhaps also one under the incipient influence of moult; and hence the porrect subsetaceous frontal zone at the base of the bill, so characteristic of Niltava, may have been wanting, as well as the hook and tooth at its point. But the legs and feet, so strictly Muscicapan (Melanops), and which, in despite of conformity in other parts of organization as well as in manners with Niltava, induce me to hesitate in classing the species under Niltava, at all events demonstrate that it is any thing but a Phœnicura.

Generis, Niltavæ, subgenus ?
Siphia nobis.
Siphya of Nepal.

Bill shorter than the head, shaped as in Muscicapa, but less broad and less armed at the point. Nares extremely advanced, partially exposed, and more shaded above by the membrane. Tarsi, elevate, slender, smooth. Digits and claws as in Niltava: thumb rather less, but not depressed nor broad. Plumage long, lax and soft. Wings and tail as in Niltava, but the wings scarcely so acuminate, having the 4th and 5th quills frequently equal. Habits and food as in Niltava; but perching and questing lower, chiefly in thick brushwood.

New species and type. Siphia Strophiata nobis. Nos. 424-474. Structure and size, $5\frac{1}{2}$ by $8\frac{1}{2}$ inches, and $\frac{1}{3}$ oz. Bill $\frac{1}{2}$. Tail $2\frac{1}{2}$. Tarsus 13-16th. Central toe 8-16th. Hind 5-16. Bill to head as 7 to 9. Muscicapan, but narrower, more cut out by the nasal fossæ, and less armed at the tip.

Frontal zone, close, velvety, not concealing the nares, but putting off curling hairs over them. Rictus short of the eye, and provided with long but slender hairs: Closed wing 3 inches, whereof the first quill is $1\frac{1}{2}$, the 2nd $2\frac{1}{2}$, the 3rd $2\frac{3}{4}$, the 4th subequal or equal to the 5th, and longest. Tertials $\frac{3}{4}$ inch less. Wings to mid-tail or more. Tail medial, firm, and even, with the caudal and alar plumes finely pointed, threadwise, as in Niltava and in several of the

Sylviadæ. Legs and feet longer and slender than in Niltava. Tarsi more than a third longer than the central digit. Toes compressed, slender, unequal: fores basally nect; the outer more so and larger than the inner fore, which scarcely exceeds the thumb. The latter, however, is not bordered nor broad. The digits are not dissimilar in form from those of Muscicapa Melanops, but they are longer and slenderer, with longer thumb, and the legs are conspicuously longer and slighter.

Colour. Mas. above, dusky slate colour, overlaid by olive, brighter and browner on the external webs of the closed wing. Alar feathers dusky: caudal black, with all the laterals whitened obliquely in the basal half. Lores, a narrow frontal band, with the throat, head, and neck, as far as the eyes, black, limited towards the breast by an orange gorget occupying the top of the breast. Above the black frontal band, a narrow white one as far as the eye, and both margined towards the superior surface of the head and neck by that deep slaty blue which covers the breast and flanks. Rest of the body below, sordid white. Bill black: legs fleshy grey: iris dark brown.

Female, rather less than her mate; her colours duller; her chin and throat unblackened, being uniformly blue with the breast; and her gorget paler, and sordid orange yellow. In both sexes the superior tail coverts are black like the caudal feathers, and there is sometimes a white band across the croup of both.

The young are at first subolive on the neck and breast as well as above, each plume being blotched with buff,—the common sign of immaturity. In them the gorget is wanting; the legs are bluish; and the bill imperfect black: but the tail soon exhibits the appropriate hues of puberty.

Remarks.—Closely allied as the Siphiæ are by the bill to Muscicapa, the elevation and slenderness of the tarsi indicate that leaning towards Sylvia which is confirmed by the food and manner of taking it, as well as by the muscularity of the stomach. These birds never seize on the wing, and they partake freely both of berries and seeds. In these respects they agree with our type of Niltava, between which and our type of Siphia there is a various gradation of form, through Brevipes and Fuligiventer, seeming to indicate the circular affinities of but *one* genus,—a genus composed almost equally of the attributes of the Flycatchers and Warblers.

GENERAL SCIENCE.

CATALOGUE OF PLANTS COLLECTED AT BOMBAY.

By John Graham, Esq.

(*Continued from page* 585.)

309. Moræa *chinensis*.
310. Mentha *perilloides*
311. Marsilea *4-folia*
312. Morus *Indica*.
313. Milhavia *tomentosa*. In gardens only.
314. Mesembryanthemum.? Ditto.
315. Nyctanthes *Arbor tristis*.
316. Nicotiana *Tabacum*.
317. Nerium *Oleander*.
318. ,, *coronarium*. } All cultivated as ornamental plants.
319. ,, *coccineum*. Rare. }
320. ,, *antidysentericum*. }
321. ,, *tinctorium*. }
322. Nymphea *lotus*.
323. Nelumbium *speciosum*.
324. Nauclea *orientalis*.
325. Oryza *sativa*. Common rice.
326. Ocimum *sanctum*. Planted at temples.
327. Ochna *lucida*.
328. Piper *nigrum*. In gardens.
329. Pladua *virgata*.
330. Plumbago *rosea*.
331. ,, *Zeylonica*.
332. Physalis *angulata*.
333. Plumeria *acuminata*.
334. Periploca *esculenta*. A very pretty twining plant; flowers during the rains.
335. Perilla *ocymoides*.
336. Polyanthus *tuberosa*. Cultivated in gardens; worn by native women in their hair.
337. Parkinsonia *aculeata*. In gardens.
338. Poinciana *pulcherrima*. Common in gardens. It grows in abundance close to the caves of Ellora, near Aurungabad, but I suppose it has all been planted.
339. Portulaca *oleracea*.
340. Psidium *pyriferum*. Grown in gardens.
341. Punica *Granatum*. Ditto.
342. Premna *integrifolia*.
343. Phlomis *Indica*.
344. Pedalium *Murex*.
345. Passiflora *fœtida*. } In gardens
346. ,, *laurifolia*. }
347. ,, *minima*. }
348. ,, *alata-cœrulea*. }
349. Pistia *Stratiotes*.
350. Pentapetes *phoenicea*. In gardens.
351. Pterospermum *acerifolium*.
352. Phaseolus *Mungo*.
353. Polygonum *glabrum*.
354. Phyllanthus *bacciformis*.
355. Pandanus *odoratissimus*.

356. Prenanthes *sarmentosus*.
357. Quisqualis *Indica*. In gardens.
358. Rhizophora *Mangle*.
359. Rosa. ? Several species in gardens.
360. Ricinus *communis*.
361. Ruellia *Zeylonica*.
362. Rottleria *tinctoria*.
363. Saccharum *officinarum*. Cultivated.
364. Smilax *aspera*.
365. Santalum *album*.
366. Solanum tuberosum.
367. " *lycopersicum*.
368. " *melongina*.
369. " *nigrum*.
370. " *jacquini*.
371. Sterculia *colorata*.
372. " *urens*.
373. " *foetida*. Poon tree. Grows to a great height in Malabar; masts are made of it.
374. Sphæranthus *Indicus*.
275. Sansevcera *Zeylonica*.
376. Sapindus *emarginatus*.
" *tetraphyllus*.
377. Spondias *Amra*.
378. Sesamum *Indicum*.
379. Sida *populifolia*.
380. Smithia sensitiva.
381. Spilanthes *alba*.
382. Salvadora *persica*.
383. Stemodia *ruderalis*.
384. Tectona *grandis*. Teak tree.
385. Tamarix *Indica*.
386. Turnera *ulmifolia*. In gardens.
387. Tradescantia *discolor*. Ditto.
388. Tradescantia *cristata*.
389. ,, *annua*.
390. Thunbergia *grandiflora*. In gardens.
391. Tamarindus *Indica*.
392. Tagites *patula*. In gardens; worn by native women in their hair.
393. Trichosanthes *Anguina*.
394. Trophis *aspera*.
395. Terminalia *Catappa*.
396. ,, *alata*.
397. ,, *Bellirica*.
398. Tabernaemontana *dichotoma*.
399. Utricularia *stellaris*.
400. Ulmus *integrifolia*. Salsette.
401. Unona *longifolia*.
402. Vitis *vinifera*. In gardens.
403. Vitex *trifolia*.
404. Vernonia *arborea*.
405. Vernonia *anthelmintica*.
406. Verbena *sativa*.
407. ,, *dichotoma*.
408. Viscum *compressum*.
409. Vangueria *spinosa*.
410. ,, *edulis*.
411. Vitmannia *elliptica*.
412. Yucca *gloriosa*.
413. Zingiber *officinale*.
414. Ziziphus *Jujuba*.
415. Zinnia *elegans*. In gardens only.
416. Zea *Mays*. Indian corn; extensively cultivated.
417. Zapania *nodiflora*.

Records of Science.

ON SOME METHODS OF ASTRONOMICAL OBSERVATION.

By William Galbraith, A. M.

Teacher of Mathematics, Edinburgh.

(*Continued from page* 586.)

All the formulæ* with which I am acquainted, and most of the tables are adapted to the sun's distance from the solstice reckoned on the ecliptic, or the difference between the sun's longitude, at the time of observation, and 90° or 270°. Now, by those possessing an ephemeris giving the sun's longitude at *apparent noon*, with differences to reduce to any given meridian, this is readily found. The sun's longitude, however, in the new Nautical Almanac for 1834, and succeeding years, is given to mean noon without differences or proportional parts, consequently, the distance of the sun, at apparent noon, from the solstice is not so easily obtained in terms of the longitude, as in those of the right ascension. Besides, in an observatory, the sidereal time is generally known by observation, and, therefore, on the whole, arguments depending on the right ascension are the more convenient for obtaining the reduction of the sun's observed declination to the solstice.

A very convenient formula for this purpose may be obtained in terms of the right ascension as follows:

Let k be the right ascension at the time of observation, δ the declination, w the obliquity of the ecliptic, and x the connexion necessary to reduce the observed declination to the solstice.

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* There are, I have since found, formulæ, though still requiring simplification, in some works on Astronomy for this purpose, and not free from obliquity.

By spherics, $\sin. k \tan. w = \tan. \delta = \tan. (w - x)$.

But $\tan. (w - x) = \dfrac{\tan. w - \tan. x}{1 + \tan. w \tan. x}$ therefore,

$$\sin. k \tan. w = \frac{\tan. w - \tan. x}{1 + \tan. w \tan. x}$$

which by reduction becomes,

$$\tan. x = \frac{(1 - \sin. k) \tan. w}{1 + \sin. k \tan.^2 w} \quad \ldots \quad (8)$$

This equation would give the reduction to the solstice, but it is not in a form to be readily applied. It admits of a transformation, however, from the following considerations, which renders it remarkably simple. Since k does not in this case differ much from 6^h or 18^h let $\Lambda = 6^h - k, k - 6^h, 18^h - k, k - 18^h$, and Λ being small $\cos. k = 1 - \dfrac{\Lambda^2}{2} + \dfrac{\Lambda^4}{24} - \dfrac{\Lambda^6}{720} + \&c.$ If this value of $\cos. k$ be substituted in formula (8) it becomes,

$$\tan. x = \frac{\left(1 - 1 + \dfrac{\Lambda^2}{2} - \dfrac{\Lambda^4}{24} + \dfrac{\Lambda^6}{720} - \&c.\right) \tan. w}{1 \left(- + \dfrac{\Lambda^2}{2} + \dfrac{\Lambda^4}{24} - \dfrac{\Lambda^6}{720} - \&c.\right) \tan.^2 w} \quad (9)$$

Now taking $w = 23^\circ\ 27'\ 40''$, $\tan. w = 0{\cdot}4340056$, and $\tan.^2 w = 0{\cdot}1883608$. By introducing these values into equation (9) it becomes,

$$\tan. x = \frac{0{\cdot}2170028\ \Lambda^2 - 0{\cdot}0180836\ \Lambda^4 + 0{\cdot}0006028\ \Lambda^6}{1{\cdot}1883608 - 0{\cdot}0941804\ \Lambda^2 + 0{\cdot}0078483\ \Lambda^4 - 0{\cdot}0002616\ \Lambda^6}$$

$\tan. x = 0{\cdot}18260684\ \Lambda^2 - 0{\cdot}0007454\ \Lambda^4 - 0{\cdot}00075777\ \Lambda^6$ &c. (10) in which Λ is the length of the circular arc to radius unity.

It is now only necessary to adopt the co-efficients of formula (10) to degrees of arc or minutes of time, as these are the terms in which the right ascension of the sun is generally given, while $\tan. x$ may in like manner be converted into seconds of arc. This is accomplished by applying the logarithms of R°, R'', &c. to the logarithms of the co-efficients of formula (10), and they become those for Λ expressed in degrees and x in seconds.

	I.	II.	III.	
Const. logs.	1·0596970,	5·154114,	1·64523.	(A)

Similarly are obtained the logs. of the constants for minutes of time when the right ascension is given in time, and the distance from the solstice is known in minutes of time and decimals.

	I.	II.	III.	
Const. logs.	9·8555770,	2·745874,	8·03287*	(B)

To render these co-efficients generally applicable, it is necessary to find the variation of x corresponding to a change of one second in w.

For this purpose from formula (9) we get

$$\tan. x = \frac{\dfrac{\Lambda^2 \tan. w}{2}}{1 + \tan.^2 w} = \frac{5}{12} \Lambda^2 \tan. w \text{ nearly, and thence,}$$

$$x = \frac{5}{12} \Lambda^2 \sin. 1'' \tan. w \quad \ldots \quad (11)$$

Differentiating equation (H) and

$$\delta x = \frac{5}{12} \Lambda^2 \sin. 1'' \frac{\delta w}{\cos.^2 w} = \frac{5}{12} \Lambda^2 \sin. 1'' \tan. \text{co. cos. } w \frac{\delta w}{\cos.^2 w}$$

* $0''.7170955\ \Lambda^2 - 0''.000000557024\ \Lambda^4 - \&c.$

since tan. + cos. = R² = 1. But $\frac{\text{cos.}}{\text{sin.}}$ = cos. therefore

$$\delta x = -\frac{5}{12}\,A^2 \sin.\, 1''\,\tan.\, w \times \frac{\cos.\, w.}{\sin.\, w} \times \frac{w}{\cos.^2 w} = \frac{x \sin.\, 1''\,\delta w}{\sin.\, w \cos.\, w}$$

and since the sin. 2 w = 2 sin. w cos. w, we have

$$\delta x = \frac{2 \sin.\, 1''\, x\, \delta w}{\sin.\, 2\, w} = \frac{\sin.\, 2''\, x\, \delta w}{\sin.\, 2\, w} \quad . \quad . \quad . \quad . \quad (12)$$

Taking δw = 1″, substituting for sin. 2 w its value when w = 23° 27′ 40″, formula (12) will become

$$\delta x = 0{\cdot}0000132748x \quad . \quad . \quad . \quad (13)$$

Log. of 0·0000132748 is 5·1230279

By this means the correction for the variation of w from 23° 27′ 40″ may be readily obtained, by adding this constant logarithm and the log. of δw in the given case to the sum of the logs. under I, the sum will be the log. of the correction of x.

Example 1. Let w = 23° 27″ 43′·76, A = 60m δw = + 3′·76, required the reduction to the solstice.

	I.	II.	III.
Const. logs. . .	9·8555770,	2·745874,	8·03287
A = 60m log. A⁴ =	3·5563025, A⁴ =	7·112605, A⁶ =	0·66891
1— + 43 1″·54 log.	3·4118795	9·858479	8·70178
2— — 0·72 C. L	5·123	2d = — 0″·72	3d = —0″·05
3= — 0·05 log. δ_w	0·575		
4= + 0·13	9·110		

x= + 43 0·90 4th= + 0″·13

A	Cor.—
′	″
20	0·01
30	0·05
40	0·15
50	0·36
55	0·54
60	0·77
65	1·08
70	1·46
75	1·96
80	2·56

When A does not exceed 30 or 40 minutes, which will in general be sufficiently distant from the solstice, the operation by the formula, even in natural numbers, becomes remarkably simple, because in that case, the second and third terms are insensible.

To render the first term applicable to every case, the sum of parts II and III may be taken from the small table in the margin, and is always to be subtracted.

Example 2. Let the sun's right ascension be 7h 16m 36s, the obliquity of the ecliptic 23° 27′ 32″·8 and, consequently, A = 1h 16m 36s, δw = 7″·2, required the reduction to the solstice?

In this way, the computation assumes the following very simple form:

Const. logarithm..		9·855577
A = 1h 16m 36s = 76m·6, log. × 2	=	3·768458
1st cor.= + 1° 10′ 7″·6 log..		3·624035
2d cor. = — 2·2 from this small table, δw = —7″·2 log	0·857	
3d cor. = — 0·4 δx from calculation. Const. log.	5·123	
x = + 1 10 5·0 = red. to solstice. δx log.. .. —	9·604	

Hence, it appears that by this formula, the reduction to either solstice is a very easy operation. From these preliminary formulæ it is now proposed to show their general application to one day's observations, consisting of six sets or three pairs, made on the 5th of July last, at Edinburgh, in latitude 55° 57′ 15″·67 N.

1834, July 5th. Chronometer fast for mean time..	2′ 40″
Equation of time with a contrary sign..	4 16
Chronometer fast on apparent time..	6 56

Barometer, $30^{in.}$ 17, attached thermometer, 70° F., detached, or that in the open air, 68° F. Or, instead of making the $6^m\ 56^s$ the error to each, it may be applied to 12^h by substraction, thus giving $11^h\ 53^m\ 4^s$ for the time of apparent noon by chronometer, a method rather more convenient.

METHOD OF RECORDING THE OBSERVATIONS.

Obs.	Time by Chronometer. *h. m. s.*	Level. *e.*	*o.*	Limb.	Ver.	Observed Altitude.	Face of Circle.
1	11 50 50					A 56° 32′ 15″	
Er.	6 56	19	16	☉'s *l.*	*l.*	B 30 15	E.
	11 43 54					C 31 0	
2	11 53 14					A 57 1 30	
E.	6 56	13	21	☉'s *u.*	*l.*	B 3 45	W.
	11 46 18					C 0 45	
3	11 55 58					A 56 36 45	
E.	6 56	23	11	☉'s *l.*	*l.*	B 34 45	E.
	11 49 2					C 35 30	
4	11 58 41					A 57 5 15	
E.	6 56	18	16	☉'s *u.*	*l.*	B 3 0	W.
	11 51 45					C 4 45	
5	12 2 31					A 56 40 0	
E.	6 56	20	13	☉'s *l.*	*l.*	B 37 45	E.
	11 55 35					C 39 0	
6	12 5 39					A 57 6 45	
E.	6 56	10	23	☉'s *u.*	*l.*	B 8 45	W.
	11 58 43					C 6 0	

$e = 103\ o = 100$ Mean of   Deg. 56 30 0

$o = 100$

$$\frac{\sum r}{n\,v} = \frac{357'\ 45''}{6 \times 3} = +\ 19\ 52{\cdot}5$$

$$e - o = 3\ \&\ l = \frac{(e-o)\,a''}{2\,n} = \frac{3 \times 5{\cdot}5}{2 \times 6} = -\ 1{\cdot}38$$

Correct mean of the whole,.. .. .. 56 49 51·12

REDUCTION TO THE MERIDIAN.

	Times. *h. m. s.*	Dist. from Mer. *m. s.*	*m*	*n*
1	11 43 54	16 6	508·77	0·62
2	46 18	13 42	368·46	0·30
3	49 2	10 58	236·10	0·14
4	51 45	8 15	133·63	0·05
5	53 35	4 25	38·30	0·01
6	58 43	1 17	3·23	0·00
			1288·49	1·12
	Mean, ...		214·49	0·1867

Reduction to the Meridian.

$\lambda = 55°\ 57'$ cos. 9·748123

$\delta = 22°\ 50'$ cos. 9·964560

A $= 56°\ 50'$ sec. 0·261952 tan. 0·1847

9·974635 × 2 = 9·9493 r

Refraction.

o. ′

Z = 33 10 log. δ O 1·5818

B = 30·17 log. 0·0025

= 70° log. 9·9991

$m = 214'' \cdot 75$ log. 2·331933 n log. 9·2711 $t = 68^\circ$ log. 9·9840

$c = + 202'' \cdot 57$ log. 2·306568 c' log. 9·4051 $r = 36'' \cdot 93$ log. 1·5674
$c' = 0'' \cdot 25$

R. M = 202·32 = 3′ 22″·32.

REDUCTION TO THE SOLSTICE.

	h.	m.	s.	
☉'s R. A. at app. noon =	6	56	8·19	at Edinburgh, $w = 23^\circ 27' 40''$
Solstice, ...	6	.	0000	

λ, or distance from solstice 6 56 8·19 = 56^m·1365.
Now by formula (B) page 10.

Constant logarithm, ...	9·855576
λ = 56^m 1365 log. × 2, ...	3·498490
1 = 37′ 39″·78 log., ...	3·354066
2 = 0·61 by small table.	

R. S. = + 37 39·17 = reduction to the solstice.

	°	′	″
Apparent altitude of the sun's centre, ...	56	49	51·12
Refraction, ...	—		36·93
Parallax, ...	+		4·67
Reduction to the meridian, ...	+	3	22·32
,, to solstice, ...	+	37	39·17
Latitude of the place of observation, ...	55	57	15·67
Sun's latitude south, ...	+		0·10
Solar equation and reduction to January 1st, ..	+		0·70
Lunar equations ☊	—		0·73
Lunar equations v	+		0·10
Mean obliquity, Jan. 1st, 1834 = Sum*—90° =	23	27	36·19
Bessel gives, ...	23	27	39·26
Error of one day's observations, ...	—		3·07

By a mean of ten days observations reduced in this manner, the obliquity was 23° 27′ 41″·64, and the difference of this from Bessel's is + 2″$\frac{1}{3}$, and from the author's, derived from the Greenwich observations, 1″$\frac{1}{3}$, a very small error, considering the nature of the problem, and size of the instrument.

(To be continued.)

* When the declination is of a contrary name to that of the latitude, the sum is the polar distance of an opposite name, and must be subtracted from 90°.

IMPORTANT FACTS DERIVED MATHEMATICALLY FROM A GENERAL THEORY, EMBRACING MANY RESULTS IN CHEMISTRY, WHICH ARE DENOMINATED ULTIMATE FACTS.

By Thomas Exley, A.M.

(Communicated to the Chemical Section of the British Association, Aug. 23rd, 1836.)

It is not for one man to build the temple of science, many must be employed.

You, veterans in science, you have collected an immense mass of materials. Many have digged for a foundation, but every one yet examined has proved sandy. It has been my lot, through the guidance of the Great Architect, to find the rock on which you may safely build.

My object is to place chemistry under the domain of mathematical science, and to establish my new theory by easy calculation and mathematical proofs.

The two principles, which form the foundation, are these; viz.

1st. Every atom of matter consists of an indefinitely extended sphere of force, which varies inversely as the square of the distance from the centre; and that this force acts *towards* the centre, and is called attraction at all distances, except in a small concentric sphere, in which it acts *from* the centre, and is there called repulsion.

2. That there is a difference in atoms, arising from a difference in their absolute forces, or in the radii of their spheres of repulsion, or in both these respects.

The theories of Newton and Boscovich agree perfectly with this, as far as regards the attraction in the first principle: after that Newton and Boscovich go together in conceiving a series of alternate spheres of attraction and repulsion governed by unknown laws, but, as regards change of direction, the forces graduate into each other. Boscovich reaches the centre with a sphere of repulsion which varies inversely as the simple distance, making the force at the centre infinite; while Newton closes with a solid nucleus, which is only an infinite force long before we reach the centre. The new theory rejects all these hypothetical, unsubstantiated forces, and their feigned alteration; and, with the utmost possible degree of simplicity, admits of but one sphere of repulsion, in which, without interruption, the law of gravitation in the attractive sphere is invariably continued down to the centre itself, where it terminates with the infinite force of Boscovich repeated an infinite number of times. The direction changes to the opposite one, *per saltum*, at the surface of the sphere of repulsion: and why not? It is quite as easy and more natural to conceive that it thus changes at once, than that it is always changing continuously backward and forward; but, which is a matter of great moment, the continuity of the quantity and of the law of force remains unbroken, preserving the delightful harmony of nature.

The inductive philosophy requires and demands this continuity in the law; unless the contrary could be shown in any instance, we have as much right to say that the law of gravitation does not exist in the infinity of places where no observations have been made, as to say it does not exist in the sphere of repulsion, that important space in which chemistry and its connate sciences produce all their phenomena.

Thus since the 1st principle as to attraction has long been established completely, by induction, and beyond the power of controversy, and since we know from facts that a central repulsion exists, the same induction obliges us to admit the same force in the sphere of repulsion, especially as not a single instance of repulsion acting according to any other law can be shewn to exist, as belonging to any atom of matter.

The 2nd principle is perfectly simple and natural, and is established by means of the first principle and induction from facts; for it is known that atoms do differ from each other, and the difference stated is in complete unison with the first principle, and quite sufficient to furnish all the variety of atoms yet observed, and an infinitely greater variety.

The material will of course be allowed, and we readily admit that the Creator originally brought into existence, according to number, weight, and measure, a quantity of every sort of atoms requisite for the purposes of his grand design in the structure of the universe.

Every variety of atoms may, according to the theory, be assumed; but to find what sorts really exist, phenomena should direct the assumptions.

In my "New Theory of Physics," it was stated that nature presents *two classes* of atoms; the one comprehending the elementary substances most generally known, such as oxygen, hydrogen, carbon, &c., which, adhering with great tenacity, may (till a better name be found) be termed *tenacious atoms*. The other included such matter or atoms as manifest their existence by motions and actions, under a form which has been denominated ethereal, and hence they may be called *ethereal atoms;* to this class was assigned the electric fluid, caloric, and light.

In the same work the atoms of electric fluid were considered as having a much greater absolute force, than those of caloric and light; and this has been abundantly confirmed by subsequent observations, entitling the electric atoms to the rank of an intermediate class. Hence, we have three classes of atoms, viz., tenacious, electric, and ethereal atoms. Of the 1st and 3rd classes there are many sorts, but probably only one sort of electric atoms; this division and arrangement will at least serve our present purpose.

The distinction of the classes is founded in a very great difference of the absolute force; that of the sorts in a moderate difference: thus, if the absolute force of an atom of oxygen be 16, and that of hydrogen 1, they will be two sorts of tenacious atoms; an electric atom must be considered very much less in absolute force than that of either of the former, and the several atoms of light and caloric perhaps many millions of times less than that of an electric atom.

In this paper the atomic weight of oxygen is 16, that of hydrogen being 1, as the unit of comparison. It appears to me exceedingly unfortunate that the British chemists have adopted 8 instead of 16; they tell us, which shews a want of confidence in their own arguments, that it is of no great consequence which of these opinions be adopted. This is indeed true as it regards many experimental determinations, but in theory it is exceedingly important. Is it of no consequence to know whether a compound contain in each particle 2, 3, 4, &c., atoms? If oxygen be 8, a particle or atom of ether contains 10 simple atoms, but, if oxygen be 16, it contains 15 atoms: would not such a difference alter all or most of its properties? A question so deeply scientific ought not to be treated with indifference.

I have not seen one argument in favour of 8 which has any great point or weight: in favour of 16 only one has met my notice which is a good one: it is this; the simple gases hydrogen, nitrogen, and chlorine, contain an equal number of atoms in equal volumes, and oxygen is as much entitled to the character of a simple gas as any of them: hence, it is reasonable to conclude it is not an exception to the rule, but this would require 16 for its atomic weight.

The following arguments appear to me decisive.

1. Sulphurous acid is the sole gaseous product, when sulphur is burnt in dry oxygen gas, and the resulting volume is the same as that of the oxygen consumed.

2. Carbonic acid is the sole gaseous product when carbon is burnt in oxygen gas, and the resulting volume is the same as that of the oxygen consumed.

3. Steam is the sole gaseous product when oxygen is burnt in hydrogen gas, and the resulting volume is the same as that of the hydrogen consumed.

4. Sulphuretted hydrogen is the sole gaseous product when sulphur is burnt in hydrogen gas, and the resulting volume is the same as that of the hydrogen consumed.

Besides, these substances have all been obtained in the form of gases and liquids; now the striking analogies before us prove, that they are formed after the same manner: but, in the opinion of all parties, the first two contain three atoms each; hence, the others contain three atoms each, and 16 is the atomic weight of oxygen.

Again, take sulphurous and hypo-sulphurous acids on the one hand, and water and deutoxide of hydrogen on the other; then, 1st. Sulphurous acid is formed by burning sulphur in oxygen gas, and the volume of oxygen is not changed; and new gas may be passed through red hot tubes without decomposition: but, several substances which have a strong affinity for oxygen, as potassium, carbon, &c., decompose it: also by a slight pressure it becomes a limpid liquid. 2nd. Hypo-sulphurous acid contains twice as much sulphur as the sulphurous acid; it is easily decomposed, and cannot remain permanent common temperatures.

Now the same sentence, with scarcely any variation, may be read for the analogous substances, water and the deutoxide of hydrogen, by merely substituting the names of these compounds and their elements. But sulphurous acid consists of two atoms oxygen and one sulphur, and hypo-sulphurous acid of one of each, whichever view of the subject be taken; hence, water must be allowed to be two atoms hydrogen and one oxygen, and deutoxide of hydrogen consists of one of each; hence, 16 is the atomic weight of oxygen.

The same sentence will nearly apply to the following couple of compounds, viz., sulphuretted hydrogen and bi-sulphuretted hydrogen: these then must agree in composition with one of the former couples, which confirms the conclusion. Many similar compounds exist and testify the same thing. One additional instance will be abundantly sufficient, taken from carbonic and nitric oxides.

1. A volume of carbonic oxide is double that of its oxygen, and combined with another volume of oxygen, it becomes carbonic acid, without change of volume.

2. A volume of nitric acid is double that of its nitrogen, and combined with another volume of nitrogen it becomes nitrous oxide, without change of volume.

It follows from these analogies, that the substances before us are composed after the same manner: now, according to both views, carbonic oxide is one atom oxygen and one carbon; hence, nitric oxide is one nitrogen and one oxygen; but by weight the constituents are in the ratio of 14 to 16, and 14 is the atomic weight of nitrogen, therefore, 16 is that of oxygen.

The other atomic weights used in this paper are taken from Dr. Thomson's determinations, doubling some of them on account of using 16 for oxygen. They are inserted in the following table, and the numbers of Berzelius are annexed; the substances in Italics are double the numbers given by Dr. Thomson.

Name.	Atomic Thomson.	Weight by Berzelius.	Name.	Atomic Thomson.	Weight by Berzelius.
Oxygen,.......	16	16.026	Arsenic,	38	75·329
Sulphur, ...	32	32.239	*Boron*,	16	21·793
Nitrogen,..	14	14.189	*Carbon*,	12	12·250
Fluorine, ...	18		*Tellurium*,	64	129·243
Chlorine,..	36	35.470	*Titanium*,	52	62·356
Bromine,..	80	79.263	*Silicon*.	16	44·469
Iodine,....... ..	126	123.206	Hydrogen,	1	1
Selenium,..	80		Mercury,	100	202·868
Phosphorus,.. ..	16	31.436	*Tin*,	116	117·839

Berzelius has, with great propriety, set down the results of his very accurate experiments without correcting them by theory; it would be well to give also the results thus corrected. From the calculated and experimental specific gravities of 57 compounds in the table appended to the 8th proposition, it appears to me, that the numbers, as given by Dr. Thomson, are nearer the truth than those given by Berzelius; and this more particularly seems to be the case in respect to two or three, which I have examined more at large, as may be seen in respect to carbon from the ten compounds in the following table. The specific gravities are calculated by a rule drawn from the 8th proposition, namely to multiply the sum of the atomic weights of the elements by the specific gravity of hydrogen, when the elements combine in single groups, and by half that sum when they combine in double groups.

Name.	Atomic wt. of carbon.	Specific By calculation.	Gravity By experiment.	Authority and result.
Carbonic oxide.	12	.9721	.9732	Thenard and Berzelius, mean; 1st ·0011 defect, 2nd ·0163 excess.
	$12\frac{1}{4}$	.9895		
Carbonic acid ...	12	1.5277	1.5213	Thenard and Gay Lussac, mean; 1st ·0064 excess, 2nd ·0238 excess.
	$12\frac{1}{4}$	1.5451		
Light carburetted hydrogen	12	.5555	.5590	Thomson; 1st ·0035 defect, 2nd ·0138 excess.
	$12\frac{1}{4}$	.5728		
Alcohol....	12	1.5972	1.6133	Gay Lussac; 1st ·0161 defect, 2nd ·0186 excess.
	$12\frac{1}{4}$	1.6319		
Etherine........	12	1.9444	1.9100	Faraday; 1st ·0344 excess, 2nd ·0691 excess.
	$12\frac{1}{4}$	1.9791		
Ether......... ..	12	2.5694	2.5830	Gay Lussac and Depretz, mean; 1st ·0136 defect, 2nd ·0558 excess.
	$12\frac{1}{4}$	2.6388		
Naphtha........	12	2.8472	2.8330	Saussure; 1st ·0142 excess, 2nd ·0663 excess.
	$12\frac{1}{4}$	2 8993		
Naphthaline.. ..	12	4.4444	4.5280	Dumas; 1st ·0836 defect, 2nd ·0032 excess.
	$12\frac{1}{4}$	4.5312		
Paranaphthal. ..	12	6.6666	6.7410	Dumas; 1st ·0074 defect, 2nd ·1860 excess.
	$12\frac{1}{4}$	6.9270		
Camphene ..	12	4.7222	4.7670	Dumas; 1st ·0348 defect, 2nd .0420 excess.
	$12\frac{1}{4}$	4.8090		

In all these ten substances, if $12\frac{1}{4}$ be taken for the atomic weight of carbon, the calculated specific gravity exceeds that found by experiment. In three of them it is so even when 12 is taken, and in the rest defect is very much less than the excess, except in naphthaline, which shews that 12 is much nearer the true atomic weight of carbon than $12\frac{1}{4}$*

Prop. 1. To determine the general effect of one, two, or more tenacious atoms placed in a vessel, in which ethereal atoms are compressed by a given force, so that of any two contiguous atoms, the centre of one is within the sphere of repulsion of the other; the tenacious atoms being separated by intervening ethereal matter.

Let the ethereal matter be compressed in a spherical vessel R T N (see plate IX, fig. 1) as by a given force on the piston T, and let *c*, a tenacious atom, be introduced. Now, for a moment, suppose the attraction of this atom not to act; on this supposition, the ethereal matter will continue to be uniformly diffused through the vessel, quite to the surface of the sphere of repulsion *h k*, within which the centres of the contiguous atoms are supported against the given pressure: let now the attraction of this atom have its full and proper effect; evidently the surrounded ethereal matter will be attracted towards it (1st prin.), and condensed on the surface of repulsion *h k*, and the change of tension in the neighbouring parts of the vessel will be quickly restored to its former state by the given pressure at T: hence, an atmosphere of ethereal matter, diminishing in density from the surface outward, will be accumulated, and retained on that surface, more or less dense, as the absolute force of the atom is greater or less, or the radius of its sphere of repulsion is less or greater.

When there are several sorts of ethereal matter in the vessel, those sorts which have the greatest absolute force, or the least sphere of repulsion, will occupy the lower strata of the atmosphere; because, whenever the equilibrium is disturbed, such atoms will be most easily moved among the rest, by the action of *c*; hence, electric atoms, if present, will form the lowest stratum.

When there are several tenacious atoms in the vessel, each will similarly retain an atmospherule on its surface.

Next, let there be two tenacious atoms, *a* and *b*, in the vessel, and let their forces on an ethereal atom at *g* be each resolved, into two, one in R N, passing through their centres, the other in *g d*, perpendicular to R N. When *d* is between *a* and *b*, the forces in R N. oppose each other, and act by their difference; but in other cases by their sum: again, the forces in *g d* always act according to their sum; and, as these forces are supported by equal forces on the opposite side, the constant effect is to condense ethereal matter on the line R N, where the most powerful ethereal atoms, and especially the electric atoms, will be chiefly collected, for the reasons assigned above.

Hence, there will be an atom, as *z*, in *a b*, undisturbed in the middle, when *a b*, are equal, in other cases, nearer to the less powerful atoms: and the atoms condensed in the line *a b* will be equally pressed and supported on all sides by the contiguous atoms.

* I have shewn from considerations connected with its specific heat, that the atomic weight of carbon must be ·75 or 12· and cannot be ·764.—*Records*, vol. ii. 38.—Edit.

Cor. When electric atoms are in the vessel, they also will retain small atmospherules of ethereal matter, which, although less dense than those of the tenacious atoms, will have considerable density, if the spheres of repulsion of the electric atoms be very small, which is probable. It is also manifest, that the atmospherules of both the tenacious and electric atoms will be more dense, when the ethereal atoms are more compressed or crowded together.

Prop. 2. Things being as in prop. 1, the actions of any two atoms on each other, combined with the mutual actions of the whole mass on each of the two, will be a repelling force between them, inversely proportional to their distance.

Let *s* be the centre of the vessel in which ethereal atoms of one sort are compressed by a considerable force: then, since the absolute force of the ethereal atoms is very small, the distance between their centres will also be exceedingly small, constituting points in a sphere such as in Newton's 73rd Prop. B. 1. Prin., and by that proposition any corpuscle or atom *a*, placed at any point of this sphere, will, by the mutual actions of the whole mass be attracted by a force proportional to its distance from the centre *s*; hence, if the atom *a* were left to the action of this resultant, undisturbed by any other influence or obstacle, it would move to the centre by a velocity determined by this law. The same reasoning applies to any other atom *b*, in the sphere; therefore, both would, in the absence of all obstacle, or other force on each other, approach, and at the same time meet in the centre, and always their distances from each other would be proportional to that of either from the centre: but this measures their accelerating force, which is, therefore, as their distance.

But, besides the mutual actions, which alone would produce the above motions, the atoms *a* and *b* act independently, and directly on each other, by an accelerating force, inversely, proportional to the square of their distance, (1st prin.); this must, therefore, be compounded with the former; thus, the force between them varies as the distance, directly, and as the square of the distance, inversely; that is, as the distance inversely.

Again, since one of the centres of every two contiguous atoms is within the sphere of repulsion of the other; the force, here investigated is a repelling force; which also appears from this, that if the compressing force were removed, the atoms would separate: hence, the proposition is true when the ethereal atoms are of one kind. But, if any number of these be removed, and their places supplied by other atoms, in such manner, that exactly the same equilibrium may be maintained, we shall still have the same conclusion.

Prop. 3. If the absolute forces or spheres of repulsion of the tenacious atoms be increased or diminished, the resultant repelling force, as determined in the last proposition, will not be altered: provided that none of the atmospherules of tenacious atoms are penetrated by the centres of others, so as to displace the atmospherules on the contiguous sides; that is, on the parts between the two tenacious atoms.

For their tendency to separate depends, not on their absolute forces, or spheres of repulsion, as is evident from the last proposition; but on the law of force, and the given pressure, and these remaining, the repelling force between the atoms *a* and *b* will also remain unaltered.

Or thus: let one of the atoms be increased in its absolute force in any ratio; then the force between it and every other atom in the vessel is increased in the same ratio: but the repulsion between it and contiguous atoms, and, consequently, between all contiguous atoms, is increased in that ratio: therefore, the equilibrium continues; that is, a variation in the absolute force produces no change of equilibrium, and their tendency to separate remains as before. The truth of the proposition is manifest, when the sphere of repulsion only is changed.

Def. 1. A single group of atoms is a collection of two or more tenacious atoms, such, that all their centres are within the sphere of repulsion of some one of them, as in fig. 4.

Def. 2. A double group of atoms is two tenacious atoms or two single groups, or one atom or single group connected by a third atom or single group, such that the connecting atom or group displaces the greatest part of the ethereal and electric atoms between the two atoms or groups which it connects, and the parts of their atmospherules on the contiguous sides, as in fig. 5 and 6.

Cor. 1. Considering a single group as one atom, there will be always in equal volumes of different gases an equal number of atoms, the pressure being given.

For, 1st, when the tenacious atoms are distinct, and separate, and of the same kind; this follows from the 2nd and present propositions; since, being in the gaseous form, they are kept apart by intervening ethereal matter; and, since they are of the same kind, they will be uniformly arranged in the vessel; therefore, on the other hand, if two gases of two given sorts occupy equal volumes, and contain an equal number of tenacious atoms, the centres will be equi-distant; therefore, the separating forces (by this and the preceding proposition) will be equal; and hence, they will sustain the same pressure; therefore when the pressure is given, the number of atoms is equal.

2nd. It is manifest from the same propositions, that a single group will occupy a volume equal to that occupied by a single tenacious atom; for, since the centres of all the atoms in the group are within the sphere of repulsion of one of them, the centre of gravity of the group may be considered as the centre of a single atom, and the contour of the spheres of repulsion as a surface of repulsion of greater magnitude; hence, it will have a single distinct atmospherule, and will act as a

single atom, and occupy (by this and the preceding proposition) the same volume; hence, the cor. is manifest.

Cor. 2. When two tenacious atoms are connected chemically, yet so as not to form a single condensed group, they will occupy, in a gaseous body, the same volume as they did before the connexion took place.

For, according to this and the last proposition, they are kept apart by the same force, as that by which they were before separated.

The connecting link will be considered afterwards: such may be called cohesive combinations.

Cor. 3. A double group will occupy in a gaseous body exactly twice the volume of a single tenacious atom, or of a single group.

For the atom or single group connecting two others, as in def. 2, displaces the ethereal atoms, and the parts of the atmospherules between them; and, because of the given pressure, the same equilibrium will be maintained; so that the connecting atom will perform the effects of the displaced ethereal matter, and, therefore, will not alter the distance between the connected atoms; the same arguments apply to single groups as to single atoms.

Cor. 4. When gases are mixed, and no chemical union, or only cohesive combination occurs, the volume is not changed.

This is manifest from the proposition, since an alteration in the absolute force or sphere of repulsion does not alter the distance between the centres of the atoms, so that each still occupies the same volume.

Remark.—If an objection be made to this proposition and its cors. by an appeal to fact, that the specific gravity of sulphur vapour is 96, that of hydrogen being 1, while the atomic weight of sulphur is only 32; it is easily obviated; for there will be perfect agreement, if the vapour of sulphur consists of single groups of two atoms each; and this is likely, since sulphur has two fusing points, and the liquid is less limpid after the second than after the first, besides other peculiarities.

If the atomic weights of phosphorus and arsenic be 16 and 38, their vapours are in single groups of four atoms each, probably in tetrahedrons, rendering them isomorphous.

It is well known that experiment bears out these mathematical conclusions.

(To be continued.)

ILLUSTRATIONS OF THE BOTANY, AND OTHER BRANCHES OF THE NATURAL HISTORY OF THE HIMALAYAN MOUNTAINS, AND OF THE FLORA OF CASHMERE.

By J. F. Royle, Esq., F. L. S., F. G. S., &c. *of the H. E. I. C. Medical Establishment.*

"The *Convolvulaceæ* are well known for the purgative properties of the roots of many of the family, as of Jalap, Scammony, &c. *Convolvulus panduratus* is substituted in the United States for the former; so, in India, *Ipomœa Turpethum, toorbud* of the Arabs, supposed to be a corruption of the Sanscrit *trivrit*, Hindee *nusot*, is accounted a powerful cathartic, and by Dr. Wallich an excellent substitute for Jalap, (v. Gordon, in Roxb. Fl. Ind. ed. Wall. 2. p. 58); so the seeds of *Ipomœa cœrulea, hub-ool-nil, kaladana*, are accounted purgative in India, as are several others of this family. The annual shoots not having secreted the due proportion of resin, are inert, and even edible; as the stalks of *C. edulis* and *repens*. The tubers of *Batatas edulis*, or sweet potato, have long been employed as food.

"*Convolvulus Scammonia*, of which the dried resinous juice forms scammony, *sukmoonya*, of the Arabs, is chiefly produced near Smyrna and Aleppo; but only inferior kinds find their way to India, though there is little doubt that it might be produced of the best quality in Northern India. The Jalap exported from Vera Cruz was supposed to be produced in that neighbourhood, or in that of Xalapa, by *Ipomœa Macrorhiza* of Michaux. But it was known to Humboldt (New Spain, vol. iii. p. 36), and also to Dr. Coxe (v. Thomson. Elem. of Mat Med. ii. p. 289), to be the produce of a different plant. The latter calls it *I. Jalapa*, and the former says, 'that the true *Purga de Xalapa* delights only in a temperate climate, or rather an almost cold one, in shaded valleys, and on the slope of mountains.' The true plant has been fully described by Professor Don, in a paper read before the Linnean Society, from specimens grown from seeds sent by Dr. Schiede, which he procured from Chiconquiera, on the eastern declivity of the Mexican Andes, at an elevation of 6,000 feet. Mr. Don retains for this the name *I. Jalapa*, instead of *Schiedeana Purga*, given it by Zuccarini and Wenderoth. The discovery of the true locality is important, as shewing that the Jalap requires a cool climate, and may no doubt therefore be cultivated in the Himalayas." Page. 308.

"The genus *Rheum*, or Rhubarb, so important in a commercial point of view, is more interesting than any other in its geographical distribution. *R. Rhaponticum* is found in several parts of Russia on the shores of the Bosphorus and of the Caspian Sea, eastwards in Siberia, and the lower mountains of the Altai range: *R. Sibericum* and *undulatum* of Pallas are considered by Ledebour to be only varieties of this. *R. Leucorhizum* (*nanum Sievers*) is also found in the Altai mountains and the deserts of the Kirghis. Neither of these afford the rhubarb of commerce, which is not found within the Russian territories, but well known to be brought by the Chinese to the Russian frontier town of Kiakhta, according to the treaty formed between these powers in 1772. The Chinese obtain the rhubarb produced in China Proper, from that part of Shensee, now called Kansu, situated betweeen N. lat. 35° and 40°. But the best, according to the Mis-

sionaries, who say, it is called *Tai hoang*, in the province of Setchuen, from the mountains called Sue-chan, or of snow, which extend from N. lat. 26° to 33°, and from about 100° to 105° of E. longitude. That, from the latter province probably forms much of what is called China rhubarb: the Missionaries met large quantities of it brought down in the months of October and November. That from Kansu may afford some of what is called Russian rhubarb; but both Pallas and Rehman have ascertained that the greater portion, if not the whole of this, is obtained in April and May, from the clefts of rocks in high and arid mountains surrounding lake Kokonor. Bell also learnt that it was the produce of Mongolia, and Marco Polo, of Succuir, in Tanguth. Dr. Rehman ascertained that the trade is in the hands of one Bucharian family, who farm the monopoly from the Chinese government, and reside at Si-ning, a Chinese town on the very frontiers of Tibet, 3,000 verstes from Kiakhta, and twenty days' journey from *Kian-sin* and *Schan-sin*, Tangutian towns, where the Bucharians go to purchase rhubarb. This would bring the rhubarb country within 95° of E. long. in 35° of N. latitude, that is, into the heart of Tibet. As no naturalist has visited this part, and neither seeds nor plants have been obtained thence, it is as yet unknown what species yields this rhubarb. Pallas thinks it may be *R. compactum*, as the leaves are said to be round and toothed; the rhubarb merchants, to whom he showed the plant, did not know *R. palmatum*. Both these were obtained from China and Tartary, as well as *R. tataricum* and *undulatum*. It is probable, therefore, that some of these yield a portion of the rhubarb of commerce, as they have some of very good quality, when cultivated in England and France. But as it is improbable, from the nature of the country, that the best rhubarb is confined within very narrow limits, it becomes interesting to ascertain how near it approaches the British territories in India, in order to share in the trade, or attempt the cultivation.

"That this might very reasonably be undertaken within the British territories, will be apparent from the distribution of rhubarb in the Himalayas. Passing from Hindoo-khoosh, where is found *Rheum Ribes* (ribas of the Persians), mentioned by Chardin, &c., more recently by Lieut. Burnes, who also met with rhubarb at Caubul and Bokhara, we find rhubarb common in the Himalayas, as on Choor, near Jumnotree, on Jocho in Kemaon, Gossainthan in Nepal, and near Tassisudon in Butan, that is, from 30° to 27°, and from E. long. 79° to 89°, and at elevations of 9,000 and 10,000 feet. Mr. Moorcroft discovered rhubarb at Niti, and next day between Niti and Gotung, that is, at elevations of 12,000 feet. His companion, Major Hearsay, thought he saw three kinds, and has described two of them to me, one round-leaved and long-stalked, and the other short-stalked, but large and broad-leaved (*R. Moorcroftianum*, nob.), with the root more purgative than that of the former. These are called *doelooh* or *dooloo* by the Bhoteas, and *tantara* (Webb), *rantra* (Hearsay). One of these appears to be the rhubarb described by Dr. Meisner under the name *R. Emodi R. Webbianum*, nob.), which differs from the original *R. Emodi*, described by Mr. Don, under the name *R. Australe*. If we turn our attention to the northern face of the Himalaya, which has so many features of a Tatarian climate, we find *R. spiciforme*, nob., discovered by Mr. Inglis on the Kherang Pass, and at several places beyond. Dr. Gerard describes the table-land of Tatary as covered with rhubarb, at elevations of 16,000 feet. Mr. Moorcroft sent some rhubarb, which, for compactness of texture, colour, and properties, was as fine as any I have ever seen, from near Ludak, in N. lat. 34°, and E. long. 77½°.

"But these are only the western boundaries of the elevated, cold, and bleak regions, known under the names of Tatary, Mongolia, and Tibet, of which Kunawur is essentially a part, participating in the same great physical features, climate, and vegetation; already possessing one, if not two species of rhubarb, and having the best growing in its immediate vicinity. There can therefore be no rational doubt about the successful cultivation of the true rhubarb in territories within the British influence, as in Kunawur, or the Bhoteah pergunnahs of Kemaon, and that with little more labour than placing the roots or seeds in favourable situations, and this in a country where little else can be produced fit for export. The only difficulty will be to obtain specimens or seeds of the true rhubarb. But it must be considered, that even the eastern boundaries of the country producing the best rhubarb, and which, to make their purchases, the Chinese reach, after a journey of twenty days, is only one half the distance from the British territories in Upper Assam, that it is from the Russian town of Kiakhta. Also, that there is reason for supposing rhubarb may be found much further to the westward, and consequently still nearer to the Himalayas. It would not therefore be difficult from Kunawur, or Upper Assam, or for such active and intelligent officers as Messrs. Traill and Hodgson, in Kemaon and Nepal, to obtain some of the seed or roots. They might at the same time succeed in establishing a trade in rhubarb with Tibet or Western Mongolia, by means of the Tatars who resort to the hill fairs. This trade might easily be encouraged by the government purchasing all the rhubuab it requires, which might thus be employed for hospital use after crossing the frontiers, instead of, as now, after making a journey of 20,000 miles, or nearly the circuit of the globe.

"Even this would not probably be so difficult as at first sight appears; for the whole of the Tatarian rhubarb trade is not engrossed by the Russians, as much of it takes a western direction, and has always formed

one of the imports from China into Bokhara, whence passing to Smyrna, it is known in Europe as Turkey rhubarb. Chardin, treating of that known in Persia, states—'La meilleure vient du pais des Tartares Orientaux qui sont entre la Mer Caspienne et la Chine' (Voyages, ii. p. 12). Rhubarb, also of the best quality, and closely resembling the Russian, is to be purchased in the bazars of N. India, under the name *rewund-khatai*, from the old name *Cathay*, of Northern China. This is sold for ten times the price of the Himalayan rhubarb, which makes its way into the plains of India through Khalsee, Almora, and Butan, and is probably, from its usual dark colour and spongy texture, the produce of either or both *R. Emodi* and *Webbianum*.* The roots of *R. speciforme* and *Moorcroftianum* are lighter coloured and more compact in structure. Rhubarb is, in India, commonly denominated *rewundcheenee* (*rivend-tchini* in Persia, *Chardin*), with *rawund* assigned as its Arabic, and *reon* as its Greek name. The above are evidently the *rewund* of Avicenna, nd the *raued-seni* of the translators of Mesue. Three kinds are described in Persian works on Materia Medica, 1. *Cheenee*; 2. *Khorassanee;* 3. *Hindee.*

"The roots of rhubarb we have seen to be pretty uniform in secreting the peculiar principle, called *Rhabarbarin*, possessing properties which make them useful as purgative medicines; but these are also accompanied by astringent properties, while the stalks secrete acid, chiefly acetic and tartaric with oxalate of lime (Fée) oxalic acid (Turner); this is most fully developed in Sorrel (*Rumex Acetosa* and *Acetosella*), while the astringent principle, dependent on the presence of gallic acid and tannin, in many of the roots of the *Polygoneæ*, is most fully secreted in *Coccoloba uvifera*, and 'so powerful as to rival gum kino in its effects.' (Lindley). Some of the *Polygonums* are, however, acrid, as *P. Hydropiper* and *acre;* and others, as *P. tinctorium*, *chinense*, and *barbatum*, yield a blue dye, like indigo, in Cochin-china, China, and Japan. The albumen of *Polygoneæ* being farinaceous, and in some considerably developed, has been used for food, as buckwheat, *Fagopyrum esculentum*, and *tataricum*, cultivated in many parts of Europe, and in the Himalayas with *P. emarginatum*. The two first are no doubt originally inhabitants of the mountains of Central Asia, and were first known in Europe under the name of 'frumentum Sarracenicum.' Both are much cultivated in Russia and Siberia; the first is usually preferred in other parts of Europe, but the second grows in every soil, and requires less time. Professor De Condolle says it is preferred to *F. esculentum* in Piedmont in the Luzerne valley, because it ripens quicker, and therefore in late years, and at higher elevations in the Alps. In the Himalayas, *Fagopyrum esculentum* (*phaphra* and *kooltoo* of the natives) is also most commonly cultivated, but *F. emarginatum* (*ogla*) which comes very near the Linnean specimens of *F. tataricum*, is preferred in higher and drier climates, as in Kunawur. Thus the more closely we examine the distribution of plants and the agriculture of different countries, the nearer do we observe the correspondence in practical results among those which participate in the same peculiarities of climate; and we cannot but admire the bounty of Nature which affords even in what appear sterile wastes, some article fitted for the food of man, and suited to the climate, with others which are adapted for commerce, as buckwheat, borax, musk, and rhubarb, from the three kingdoms of Nature, in the cold, bleak, and arid plains and mountains of Tatary." Page 314 to 317.

"The herbaceous parts of many of this family, (*Chenopodiæ*) as spinage, &c. being insipid and mucilaginous, have been used as vegetable food in many parts of the world; so, in India, are several species of *Chenopodium* (bhutwa, &c.), *Beta bengalensis* (palung and paluk), *Spinacia tetranda* (isfanaka), and also *Basella rubra* (poee). The roots of beet and mangel wurzul also afford food: the successful extraction of sugar from the former is one of the triumphs of science. The seed of some are considered aromatic and stimulant, as *Chenopodium Botrys*, and *Ambrosoides*. *C. vulvaria* is said by Mr. Chevalier to exhale ammonia during the whole of its existence (Lindley, Nat. Ord. p. 168). The loose cellular texture of many of this family is supposed to favour the absorption and deposition of soda in their substance, when growing in the vicinity of the sea; and this in such considerable quantities, as to afford, by the incineration of several species of *Salsola*, *Salicornia*, *Sueda*, &c., the chief supply of the barilla of commerce on the coasts of Spain, the S. of France, and of Arabia. Dr. Roxburgh has already suggested (Flor. Ind. 2. p. 62), that *Salicornia indica* and *brachiata*, with *Salsola nudiflora*, are so abundant on the coasts of India, as to be able to supply barilla sufficient to make soap and glass for the whole world. A coarse kind of barilla is procurable in Indian

* "That the rhubarb of this species is not without some valuable properties, we may learn from Dr. Twining's report on experiments made on forty-three cases in the general hospital, Calcutta, of which the following are extracts:—Dr. T. states, that it has 'less aroma and more astringency to the taste than the best Turkey rhubarb; in doses of 2 or 3 drs. it has a good purgative effect, operating three or four times, nearly as freely as the best Turkey rhubarb. The effects of small doses of the remedy, as a tonic and astringent, are highly satisfactory, as far as four or five cases can be relied on. In this respect its efficacy appears to be superior to corresponding quantities of the best rhubarb. On the whole, it appears not an eligible remedy in obstinate costiveness, on account of its aroma and astringency; 'it is not apt to gripe," but it is very efficacious in moderate doses for such cases as rhubarb is generally used to purge; and its cultivation at the Mussooree garden may be expected to afford a very valuable remedy, which is less disagreeable to take than the best Turkey rhubarb, nearly equally efficacious as a purge, and very superior in small doses as a tonic and astringent in profluvia."—*Trans. Med. and Physic Soc. of Calcutta*, vol. iii. p. 441.

bazars, under the name *sejjee muttee* (soda-earth). This is procured by the incineration of plants (unknown) growing not in the neighbourhood of the sea, but on the shores of the salt lakes scattered through the Indian deserts. It seems worthy of inquiry, whether the *Salsola*, so abundant on the banks of the Jumna, would yield soda, and, also, whether it would be possible to grow any of these soda-secreting plants in the saline and barren country to its westward, where nothing else will now grow." Page 319.

"The *Myristiceæ*, usually placed near *Laurineæ*, are considered by Dr. Lindley more closely allied to *Anonaceæ*. They are natives exclusively of the tropics of India and America. In the Old World, they extend southwards from the tropical islands to New Holland, and northwards along the Malayan peninsula to Silhet, where is found *M. longifolia*, Wall., and in the mountains of that district *M. floribunda*, Wall., with *M. angustifolia*, Roxb. Other species are peculiar to the peninsula.

"*Nutmeg* forming the albumen, and *Mace* the arillus of the seed of *Myristica moschata*, are well known for their grateful and aromatic properties. They are produced in the largest quantities in the Moluccas, but have been succesfully cultivated in Penang and Bencoolen, but especially in Sumatra. The trees thrive and bear fruit even so far north as the Calcutta Botanic Garden, and might no doubt be successfully cultivated in Travancore and the Tinnivelly district, as well as on the Malayan peninsula. The nutmeg is called *juephul* in India, with *jouz boa* (fragrant nut) as its Persian name; and mace—*jawuntree*, *P. bisbaseh* with *amakhun* assigned as its Greek name. Other species yield aromatic nuts, as *M. tomentosa*, perhaps the *M. dactyloides* of Gærtner; *M. officinalis*, according to Dr. Martius, in Brazil, and *M. Oloba*, in Santa Fè. The plants of this family, like those of the following, have a volatile as well as a fixed oil, contained in their nuts. The latter is so abundant in *Virola sebifera*, as to be extracted for economical purposes. Like many of the *Laurineæ*, the *Myristiceæ* exude an acrid reddish-coloured juice from incisions in their bark." Page 323 to 324.

"The properties of Indian *Euphorbiaceæ* correspond with those which have been observed in plants of this family in other parts of the world. All abound in a milky juice, which contains *Caoutchouc*, and is generally united with a highly acrid principle of a very volatile nature, and therefore easily dissipated by heat. According to the degree of concentration of this principle is the innocuous or deadly nature of the substance with which it is combined. Thus the seeds of some *Euphorbiaceæ*, in which it exists in small quantity, are eaten; as those of *Aleurites ambinux*, and of *A. triloba*, in India: the fruit of *Cicca disticha* is acid, as is that of *Emblica officinalis*, forming *Emblic myrobolans*. Though united with fecula in the roots of *Jatropha Manihot* or the Cassava, so that they are poisonous when raw, it is so effectually separated by heat, as to afford an abundant and nourishing food to thousands in S. America, the West-Indies, and Mexico. The plant succeeds completely in India, but it is remarkable that it should have been made so little use of, though Sir W. Ainslie has mentioned making *Tapioca* from it when in India. This acrid and stimulant principle is combined with fixed oils in many of the seeds of *Euphorbiaceæ*, which are well known for their uses as purgative medicines, as the castor oil plant, *Ricinus communis*, *khiroa* or *cherua* of the Arabs, *arunda* of the Hindoos, and of the Greeks; and also several species of *Jatropha*, as *J. Curcas*, physic-nut (*H. bagh-burinda*) J. glandulifera is used as an escharotic to remove opacities of the eye in India (Roxb.) The most active, being at the same time safe and which is perhaps the most extensively used in India, and also considered emmenagogue, is the *Croton Tiglium*, Grana Molluccana and Tilli of old Pharmacopœias, *jumalgotta* of the Hindoos, *dund* of the Arabs and Avicenna, for which, in N. India, those of C. *polyandrum* are substituted, and called by the same name. Species of *Phyllanthus* are considered diuretic, others of the order sudorific, and some emetic. The best substitutes for Ipecacuanha are said to be some species of *Euphorbia*, as *E. Ipecacuanha*, *Gerardiana*, &c.; also *Pedilanthus tithymaloides*. Space would fail, if we were merely to enumerate all those to which useful properties have been ascribed, but they may be seen in the Essay of M. Adrien de Jussieu, Lindley, Fée, Roxburgh, and Ainslie. The acrid and stimulant principle is united with essential and fragrant oil in some barks and woods, as in *Croton Cascarilla*, *Eluteria*, and *gratissimum*. The wood-cutters of the Delta of the Ganges state, that no *Agallochum* is afforded by *Excœcaria Agallocha* (Roxb.). A peculiar principle (*cereo-resine*, Fée), called *Euphorbium*, *furfiyoon*, (Gr. *afirbiyoon*) of the Persian works on Materia Medica, and said in them to be a produce of Soudan and Africa, is considered by botanists to be yielded by *Euphorbia officinarum*, *Canariensis*, and *antiquorum*. I doubt whether the last, at least the species so called in India, yields any, as in some experiments I made on the subject, I found the juice comparatively inert. The leaves of *E. nereifolia* are considered purgative and deobstruent (Ainslie); the root of *E. ligularia* mixed with black pepper, is employed for the cure of snake-bites. Some of this family are violent poisons, as *Hippomane Mancinella*, *Hura crepitans*, *Hyœnanche globosa*, *Excœcaria Agallocha*, *Sapium aucuparium* and *indicum*. Seeds of the latter intoxicate fish, as does the bark of *Fluggea virosa* (Roxb.), and the hairs of some species, as *Tragia cannabina* and *involucrata*, sting as violently as nettles. Some species yield oil useful for burning, as *Elœcocca* (*Dryandra*, Thunb.), *verrucosa*, and *Vernicia*, the oil and varnish trees of China, *Aleurites triloba*, *Ricinus communis*, &c.; while *Stillingia sebifera*, or tallow-tree of China, yielding a vegetable fat, is now common about Calcutta, but it is

only during cold weather that this substance becomes firm (Roxb.). The most useful product of the family, however, and that which has lately become so important an article of commerce and of great utility in a variety of arts, is *Caoutchouc*, so well known as *India-rubber*, and exported principally from Para. This is chiefly yielded by *Siphonia elastica (Hevea guianensis*, Aubl.), a tree of Guiana and Brazil, which would no doubt thrive in Bengal. *Caoutchouc* is also imported from Penang, the produce of *Urceola elastica* (As. Res. v p. 157 and 167), but I hope it will be also from the continent of India.

"The expressed oil of the seeds of *Jatropha Curcas*, boiled with oxide of iron, is said to form the varnish used by the Chinese for covering boxes (Lindley). The juice of this plant is of a very tenacious nature, and when blown into, forms very large bubbles, probably owing to the presence of *Caoutchouc*; this is also afforded by an African tree of this order.

"The dye, called *Turnsol*, is yielded by *Crozophora* (*Croton*) *tinctoria*, as it is a coloring matter by *C. plicata* (v. Roxb. Fl. Ind. iii. p. 68); also by *Rottlera tinctoria*, of which the strigose pubescence, like that of *Mucuna pruriens*, is administered for expelling intestinal worms. Several of this family yield hard and valuable timber in India, as *Emblica officinalis*, *Rottlera tetracocca*, *Adelia castanicarpa*, species of *Briedelia*, *Cluytia*, &c. African oak or teak is supposed by some to belong to this family.

"Though belonging to so dangerous a family, the leaves of *Plukenetia corniculata* are said to be eaten as a vegetable; and the domesticated Arindy silkworm (*Phalæna Cynthia*,) is fed upon the leaves of *Ricinus communis*. (Roxb.)" page 327 to 329.

"The tribe of Peppers is well characterized by the warm, pungent, and aromatic properties for which some of the species have been celebrated from the earliest to the present times, either as condiments, or for their uses as stimulant and stomachic medicines. Of these, *Piper nigrum*, affording the black and white pepper (Pers. *pilpil*) of commerce, is, no doubt, the most celebrated. That of Malabar has long been considered the best; but that of Sumatra, and many of the islands, is reckoned nearly as good. Mr. Crawford states, 'the pepper countries extend from above the longitude of 96° to that of 115° E., beyond which no pepper is to be found, and they reach from 5° S. lat. to 12° N., where it again ceases. Within these limits, we have Sumatra, Borneo, the Malayan Peninsula, and certain countries lying on the east coast of the Gulph of Siam.' It is cultivated all along the Malabar coast, and also near Courtallum. Dr. Roxburgh describes it as being found wild in the hills of the Rajahmundry district. But this may be the species which he describes under the name *P. trioicum*, of which I have seen no specimens; but the pepper Dr. R. states to be 'exceedingly pungent, and by merchants at Madras reckoned equal, if not superior to the best pepper of the Malabar coast or Ceylon.'

"The betle-leaf, *P. Betle*, *pan* of the natives, Sans. *Tamboolee*, Pers. *tumbol*, so well known for its moderately pungent and aromatic properties, is cultivated throughout tropical Asia, and over a great part of India. I have seen it as high as Bundlecund and the southern parts of the Doab, though it requires a rich moist soil, and shady situation. These are obtained in Northern India by irrigation, and covering the plants around and above with a light thatch of grass or reeds. *P. longum*, *pippul* of the natives, and the root *pippula-moola* and *peeplamoor* is cultivated in Bengal and the Circars, both for its pepper and its roots: the former in use as a condiment, and the latter extensively so as a stimulant medicine. *P. chaba* (As. Res. ix. 391) is called *mugpeepul*, and similarly used. The root of *P. methysticum* is that employed in the Society and Friendly Islands, under the name of *Ava* or *Kava*, to produce by fermentation a pungent and stimulant beverage. *P. inebrians* is substituted for it. *P. anisatum*, as its name implies, smells of Anise; other species possess the general pungent and stimulant properties of the family. *P. Cubeba*, grown in Java and Penang, affords the well known *Cubebs*, which are the *kubabeh* of the Arabs, *kubab-cheenee* of the Hindoos; for these *kurfiyoon* is assigned as the Greek name, intended probably for *Carpesium*, as this has been supposed by some authors to be cubebs. The seeds of *tezbul*, *Xanthoxylum hostile*, p. 157, are said to be one kind of cubebs. They have much the same warm, pungent, and stimulant properties." Page 332 to 333.

"The HEMP (*Cannabis sativa*), so well known in Asia from affording an intoxicating drug, and in Europe the strongest fibre for rope-making, is cultivated for the former product in small quantities every where in the plains of India, near villages: but in the Himalayas it is extremely abundant, at elevations of 6 000 and 7,000 feet, and of very luxuriant growth, rising sometimes to a height of ten and twelve feet. Here, though it likewise affords an intoxicating drug, it is also known for the tenacity of its fibre, which is employed by the mountaineers in Gurhwal and Sirmore for making a coarse sackcloth, and strong ropes for crossing their rivers. Considering that this fact was early made known by Col. Kirkpatrick in his account of Nepal, ascertained by Gen. Hardwicke in his journey to Srinuggur, and repeated by Dr. Roxburgh in his account of experiments on substitutes for hemp; it is remarkable that no one should yet have attempted to obtain it for commercial purposes, particularly, as during the late war so many attempts were made to find an efficient substitute for this important plant; and so many others are cultivated in India for the product which this yields of so superior a quality. It may be mentioned, that I have seen it abundant in the Deyra Doon and plains of Northern India, especially in the upper part of the Doab Canal; of these only a small portion is employed for making *bhang*; but this might

probably be obtained from the leaves, even while the stems yielded the fibre.

"The hemp is supposed by some to be a native of India; it no doubt is so of some part of Asia. It appears to be wild in the Himalayas. The Arabic name *kinnub* is thought to have been corrupted into the Dutch *hennep*, whence we no doubt have our *hemp; kinnabis* is given as its Greek name by the eastern writers on Materia Medica; *bunj* as Persian and *bhung* and bhang as Hindee. It is said by Herodotus to have been made into cloth by the Thracians, and is now well known to be extensively cultivated in Italy, Poland, and Russia to the south of Moscow, with a small quantity only in England. It requires a rich soil and moist situation; is pulled when in flower, if the fibre alone be required, but if the seed also, then the male plants are pulled as soon as they have shed their pollen, and the others when the seed is ripe. These yield oil, which is employed by painters, or they are used for feeding poultry, so that every part of the plant is turned to some account. The leaves are sometimes smoked in India, and occasionally added to tobacco, but are chiefly employed for making *bhang*, and *subzee*, of which the intoxicating powers are so well known. But a peculiar substance is yielded by the plants in the hills in the form of a glandular secretion, which is collected by the natives pressing the upper part of the growing plant between the palms of their hands, and then scraping off the secretion which adheres. This is well known in India by the name *cherris*, and is considered more intoxicating than any other preparation of this plant, which is so highly esteemed by many Asiatics, serving them both for wine and opium; it has in consequence a variety of names applied to it in Arabic, some of which were translated to me, as 'grass of fuqeers,'—leaf of delusion,'—'increaser of pleasure,'—' exciter of desire,'—' cementer of friendship,' &c. Linneus was well acquainted with its 'vis narcotica, phantastica, dementens.' It is as likely as any other to have been the *Nepenthes* of Homer. Besides *kinnabis*, it has *defroonus* assigned as a Greek name.

"It is interesting to find in the same family with the hemp, the *Urtica tenacissima* of *Calooee* of Marsden, *Rami* of the Malays, a native of Sumatra. also of Rungpore, where it is called *kunkomis*, and which Dr. Roxburgh found one of the strongest of all the vegetable fibres, which he subjected to experiment. Average weight with which lines made of the different substances broke, were, *Asclepias tenacissima*, *Jetee* of the Rajmahl mountaineers, 248; *Urtica tenacissima*, *Calooee*, 240; the strongest *Sunn*, *Crotolaria juncea*, 160. Hemp, *Cannabis sativa*, grown in the year 1800, in the Company's Hemp Farm near Calcutta, 158, but much stronger when tanned. Europe hemp, however, was always found stronger than Sunn, though not more so than the others. Dr. Roxburgh speaks of the beauty, fineness, and softness of the fibre of this plant, and says, he learnt from a friend resident at Canton, that grass-cloth of China is made of this material. It is cultivated in Sumatra for the fibres of its bark. The Malays use it for sewing-thread and twine, and for making fishing-nets. It is as readily cultivated as the willow from cuttings, grows luxuriantly in the northern, as in the southern parts of India, throws up numerous shoots, as soon as they are cut down, which may be done about five times a-year. Dr. Roxburgh, however, found some difficulty in cleaning the fibres of this plant, notwithstanding his anxious desire to succeed with this substitute for both hemp and flax. *Urtica heterophylla* is another Indian nettle, which succeeds well in every part, and of which the bark abounds in fine white, glossy, silk-like strong fibres, (Roxb.) The stinging properties of the nettle are well known, but they are all exceeded by the 1st mentioned plant, as well as by *U. crenulata* and *stimulans*.

"The Hop (*Humulus Lupulus*) is another plant of this family, which affords fibre fit for rope and cloth-making, and which would be a valuable acquisition to India, as many situations at moderate elevations are admirably fitted for the brewing of beer. In one establishment which I visited several times, the temperature within the buildings never varied much from 60°. The hop is also a remarkable instance of the change of prejudice with regard to the same thing. Thus, at an early period, in the petition against it, we hear of it as the 'wicked weed called hops;' in a subsequent age we find it noted as a subject of admiration, that 'on Kent's rich, plains green hop-grounds scent the gales, and now, many think, that no beer can be made without it. The plant grows wild in most parts of Europe, and is described further south by Bieberstein, in his Flora Tauro-Caucasica, as 'copiosa in dumetis et sepibus., It requires a rich strong soil, especially if it be rocky a few feet below the surface. It is planted in October or March, shoots up about the middle of April, flowers in July, and ripens its seeds in September. Warm seasons, without wet, are required for good crops; great heat after rains, and high winds, are destructive. It might be cultivated in Nepal, or, perhaps, the Deyra Doon; but it is feared that the rainy season would interfere much with the proper growth of the plant. The subject is well worthy of experiment, and a few plants would suffice to ascertain the effects of the seasons." Page 333 to 335."

CONSIDERATIONS ON A NEW FORCE ACTING IN THE FORMATION OF ORGANIC COMPOUNDS.

By M. Berzelius.

(*Jahrbuch de Schumacher, for* 1836.

When new compounds are produced in inorganic nature as the result of the re-action of different bodies, it is in consequence of a mutual tendency of those bodies to satisfy the laws of their affinity, in a more complete man-

ner. First, the substances possessing dominant affinities enter into combination, and then those of feeble affinities which were excluded from the first combination. Before the year 1800, the existence, in these phænomena, of any other determining cause than the degree of affinity, heat, and, in some cases, light, was scarcely suspected. The influence of electricity was then discovered, and we soon saw ourselves in danger of confounding the electrical with the chemical relations of bodies, and of considering their affinities only as the manifestation of a strong electrical contrast, increased by light and heat. This system offered no other means of explaining the origin of a new compound, than by the supposition, that, by the approximation of bodies which are present, their electrical states become neutralized in a more perfect manner.

Setting off from these ideas, deduced from the effects which occur in inorganic nature, and studying the chemical re-actions presented by organized bodies, we perceived that in the organs of the latter substances the most various were elaborated, while the brute matter, whence they proceeded, consisted, in general, of but one liquid circulating in vessels with more or less velocity. The vessels of the animal body, for example, pump blood from their origin without interruption, and, nevertheless, secrete milk, bile, urine, &c. at their extremities, without admitting any other liquid capable of producing, by double affinity, any decomposition whatever. A fact here evidently occurs, which the study of inorganic nature was then unable to explain.

At this period M. Kirckhoff observed, that starch, dissolved in diluted acid, became converted, at a certain temperature, first into gum, and afterwards into grape-sugar. In conformity with the principles then received with regard to effects of this kind, an endeavour was made to ascertain what the acid had removed from the starch to reduce it into sugar; but no gas had been disengaged, the acid re-appearing by means of the alkalies in its primitive quantity, had not been combined, and the liquid contained only sugar in an equal, or even a larger, quantity than the starch which had been employed. The cause of this alteration was as problematical as that of the secretions in the organic body. M. Thénard then discovered the peroxide of hydrogen, a liquid, the elements of which are retained in combination by a very weak affinity. The acids do not produce any alteration in it; the alkalies, on the contrary, produce in it a tendency to decomposition, a species of fermentation, which re-produces water, in consequence of a disengagement, of oxygen. But the most interesting circumstance is, that the same effect takes place from the action of different solid bodies insoluble in water, organic as well as inorganic; for example, from the presence of peroxide of manganese, of silver, platinum, and also the fibrin of animal blood. The body whch determines the decomposition does not undergo any alteration, it does not act as an element of a new compound, but by virtue of a peculiar force inherent in its mass, the existence of which, though unknown in its essence, is demonstrated by its effects. Shortly before M. Thénard, Sir H. Davy remarked another phænomenon, the analogy of which with the one just described, was not immediately perceived. He had proved that platinum, heated to a certain degree, and brought into contact with a mixture of the vapour of alcohol, or ether, and atmospheric air, possessed the power of determining and sustaining the combination of these bodies, while gold and silver were devoid of this property. Soon after, Mr. E. Davy discovered a preparation of platinum in a state of very great mechanical division, having, at ordinary temperatures, and after being moistened with alcohol, the property of becoming incandescent by the combustion of alcohol altogether, in converting it by oxidation into acetic acid. Then followed the discovery of Döreiner, the most important of all. He proved that it is the property of spongy platinum to inflame spontaneously a current of hydrogen gas projected in the air; a phænomenon which the researches of M. M. Thénard and Dulong proved, is produced by several other bodies, simple as well as compound: with this restriction, however, that, while platinum, iridium, and some other affinal metals, act at temperatures below zero, other bodies, such as gold, and more especially silver, require a much higher temperature, and glass a heat even of above 300°. Thus what was at first considered as an exceptive mode of action, appeared to be a general property though, variously graduated, of all bodies, and from the application of which, advantage might be derived. We know, for example, that in the act of fermentation, in the conversion of sugar into alcohol and carbonic acid, the action exercised by the insoluble substance named leaven, and which may be replaced, though with less success, by animal fibrin, albumen, and gaseous substances, &c. cannot be explained by any chemical re-action of the affinities of the sugar and the leaven, and that no effect in inorganic nature approaches it so nearly as the action of platinum, silver, or fibrin, in the decomposition of the peroxide of hydrogen into oxygen and water. It was natural here to suppose an analogous mode of action. The conversion of starch into sugar, by means of sulphuric acid, had not yet been co-ordinated with the preceding facts; the discovery however of diastase (announced in the Annual Report for 1833), a substance acting upon starch in an analogous manner, only with more energy, directed attention to this analogy, which was definitively proved by the ingenious researches of M. Mitscherlich upon the formation of ether. Among the numerous theories upon the formation of ether one, we know, makes the property of sulphuric acid to convert alcohol into ether, to depend upon its power of absorbing water, granting, that the alcohol, considered as a compound of one atom of etherine (C_4 H^3), and of two atoms of water, is reduced into ether, by ceding the half of its water to the acid. This theory, equally simple and inge-

nious, was in perfect agreement with our knowledge of the re-action of the affinities of bodies; it did not, however, explain why other bodies not acids, having equal avidity for water, could not be employed in the same manner; why soda, potash, chloride of potassium, anhydrous lime, &c., if the transformation really depended only upon an affinity for water, did not equally produce ether. The researches of M. Mitscherlich proved that sulphuric acid, sufficiently diluted, and taken at such a temperature that the refrigeration produced by the addition of the alcohol compensated for the heating which arose from the mixture, decomposed the alcohol into ether and water, which, because the temperature exceeded the temperature of ebullition of water, were both separated by distillation from the mass, and, as soon as the condensation was complete, presented a mixture of the same weight as that of the alcohol employed. The manner of performing this experiment, as well as the fact of the distillation of water conjointly with alcohol, was, it is true, known before M. Mitscherlich, but to him belongs the merit of having predicted its consequences. In fact, he proved that, at this temperature, sulphuric acid must act upon alcohol by virtue of the same force which determines the action of the alkalies upon oxygenated water, since the water being entirely separated from the mixture, did not obey an affinity for the acid; whence he concluded, that the action of sulphuric acid and diastase upon starch, from which resulted the sugar, must be of the same nature.

It is then proved that many substances, simple or compound, solid or in solution, have the property of exercising an influence upon compound bodies essentially distinct from chemical affinity, an influence which consists in the production of a displacement and a different arrangement of their elements, without participating in it directly and necessarily, except in a few special cases. Certainly a force such as this, capable of producing chemical re-actions in inorganic nature, as well as in organized bodies, though at present too little understood to be well explained, must exercise a more important function in nature than has hitherto been supposed. In defining it as a new force, I am far from wishing to deny that a certain connection exists between it and the electro-chemical relations of matter. I am, on the contrary, strongly disposed to recognize in it a decided manifestation of these relations; nevertheless, till we have penetrated into the real nature of this force, it will be more simple in our future researches to consider it as independent, and to give it, for facility of recognition, a name peculiar to itself. According to an etymology well known in chemistry, I shall consequently name it the *catalytic force* of bodies, and the decomposition which it determines *catalysis*, in the same manner as the separation of the elements of a compound, by means of the usual chemical affinities, is called *analysis* This force may be defined to be a power of bodies to bring into activity, by their simple presence, and without participating in it chemically, certain affinities, which at that temperature would remain inactive, so as to determine, in consequence of a new distribution of the elements of the compound, a new state of perfect chemical neutralization. As this force acts in general in a manner analogous to heat, it may be inquired whether being variously graduated, sometimes by employing differently the same catalytic body, sometimes by the introduction of various catalytic bodies in the same liquid, it will cause as is often observed in the action of heat at different temperatures, different catalytic products,—whether the catalytic force of a body can be exerted over a larger number of compounds, or whether, as our experiments appear to indicate, only over certain bodies, to the exception of certain other bodies? But in the present state of our knowledge it is impossible to decide these questions, and many others that might be proposed upon the subject: their solution must depend on the results of future investigations. It is enough for the present to have shewn, by a sufficient number of examples, the existence of this force, which, defined as it has been, diffuses a new light over the chemical re-actions of organized bodies. We shall cite but one example. There is an accumulation of diastase around the eye of the potatoe, which is not found in the tubercle or in the developed germ; we perceive in this point a centre of catalytic action, at which the insoluble starch of the tubercle is converted into gum and sugar, and this part of the potatoe will become the secretory organ for the soluble sustances, which are to form the juices of the growing germ. It is not probable that the action mentioned is the only one of its kind in vegetable life; on the contrary, it may be presumed, that in vegetables, as well as in the animal body, a thousand catalytic effects take place between the tissues and the liquids, whence results the great number of different chemical compounds, the production of which, from the same brute matter, which we call blood, or vegetable juices, cannot be explained by any other known cause.—*Bibliotheque Universelle, Nouv. Ser. Tome ii., p.* 376.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY, 1836.

(*Continued from page* 594.)

Jan. 12, 1836.—A note addressed to the Secretary by Sir Robert Heron, Bart. M.P., was read. It referred to the writer's success in the breeding of *curassows* in the last summer at Stubton.

From two individuals in his possession, the male of which is entirely black, and the female of the mottled reddish brown colour which is regarded as characteristic of the *Crax rubra*, Linn., Sir R. Heron has hatched in the last year six young ones in three

broods of two eggs each: the eggs were placed under turkeys and common hens. Respecting one of them no notes were made; but the other five were all of the red colour of the female parent. Two of these, which were at two or three weeks old very strong, being still in the flower-garden, were killed in the night by a rat that had eaten its way into the coop in which they were. Two others were sent to the Earl of Derby, who wanted hens. The remaining one is now nearly, if not quite, full grown; and Sir R. Heron proposes to place it with the old pair.

"There is one great peculiarity," Sir R. Heron remarks, "attending the old pair. Their principal food is Indian corn and greens, both which they eat in common: but whenever any biscuit is given to them, as an occasional treat when visitors are here, the male breaks it and takes it in his mouth; waiting, however long, until the hen takes it out of his bill, which she does without the slightest mark of civility, although on excellent terms with him. This proceeding is invariable."

Mr. Yarrell, on behalf of T. C. Heysham, Esq., of Carlisle, exhibited the egg, the young bird of a week old, one of a month old, and the adult female of the *Dottrell*, *Charadrius Morinellus*, Linn., obtained on Skiddaw in the summer of 1835. Several pairs were breeding in the same locality.

He also stated that a specimen of the *grey Snipe*, *Macroramphus griseus*, Leach, a young bird of the year, has been obtained near Carlisle in the past year. This is the third recorded instance of the occurrence of the species in England.

Some notes by Mr. Martin of a dissection of a *Vulpine Opossum*, *Phalangista Vulpina*, Cuv., were read, and are given in the "Proceedings.

A notice by Dr. Rüppell, For. Memb. Z. S., of the existence of canine teeth in an Abyssinian *Antelope*, *Antilope montana*, Rüpp., was read. It was accompanied by drawings of the structure described in it, which were exhibited.

The following is a translation of Dr. Ruppell's communication.

In several *Mammalia* of the order *Ruminantia* the adult males, and even some females, possess canine teeth, which are more or less developed; to these teeth, no other use has been attributed than that of a weapon of defence. The *Camels* (*Camelus*), the *Musk Deer* (*Moschus*), and the *Muntjak* of India (*Cervus Muntjak*), possess these canine teeth in both sexes. In the *red Deer* (*Cervus Elaphus*), and in the *rein Deer* (*Cerv. Tarandus*), the adult males alone are provided with them.

I have just ascertained that there is a species of *Antelope* which possesses these canine teeth; but in which, by a singular anomaly, it is only the young males that are furnished with them. In these too they can only be considered in the light of half-developed germs; for the cartilaginous part which covers the palate and the upper jaw entirely conceals them.

It is the *ant. montana*, which I discovered in 1824 in the neighbourhood of Sennaar, and of which I published in my 'Zoological Atlas' the figure of an adult male, that is provided, in its youth, with these anomalous canine teeth: the adults of both sexes, and the young females, are destitute of them. I observed, in my last journey in Abyssinia, many individuals of this species in the valleys in the neighbourhood of Gondar: it is far from rare in that locality, but the jungles mingled with thorns, which are its favourite retreat, render the chase of it extremely difficult.

At the time of the publication of my description of this new species, in 1826, I was possessed of only a single adult male, and there were consequently many deficiencies in my account of it. I am now enabled to add to this notice that the females of this species are always destitute of horns: that both sexes have, in the [groins] two rather deep pits covered by a stiff bundle of white hairs, and finally that the species live in pairs in the valleys of the western part of Abyssinia, where it takes the place of *Ant. Saltiana*, an animal which it exceeds in size by nearly one half. These two species are called by the natives *Madoqua*, by which name the Abyssinians also designate the *Ant. Grimmia*, which equally constitutes a part of the game of that country, so rich in different forms of the *Ruminant* order —E. R.

A note by Mr. Martin was subsequently read, in which it was stated that it had once occurred to him to observe a rudimentary canine tooth in the female of a species of *Deer* from South America, the body of which had been sent to the Society's house by Sir P. Grey Egerton for examination. Having noticed an enlargement of the gum of the upper jaw, in the situation in which a canine tooth might possibly be supposed to exist, he cut into it, and found the germ of a canine tooth, about 3 lines in length, imbedded in the gum, and destitute of fang.

Jan. 26.—Specimens were exhibited of numerous *Birds*, chiefly from the Society's

collection; and Mr. Gould, at the request of the Chairman, directed the attention of the Meeting to those among them which he regarded as principally interesting either on account of their novelty or for the peculiarity of their form.

They included the following species of the genus *Edolius*, Cuv., which were compared with numerous others placed upon the table for that purpose.

Edolius *grandis*, *Rangoonensis*, *Crishna*, and *viridescens*.

Of *Edolius Chrisna* a very curious character is furnished by the long, hair-like, black filaments which spring from the head and measure nearly 4 inches in length.

(To be continued.)

THE INDIA REVIEW.

Calcutta: March 15, 1837.

LORD AUCKLAND'S FIFTH SCIENTIFIC PARTY.

Tuesday, 14*th April*, 1837.

On this occasion Dr. O'Shaughnessy showed the properties of carbonic acid, and its effects on flame and animal life. Carbonic oxide, carburet of hydrogen, and the olefiant gas or heavy carburetted hydrogen came under explanation, which led to the consideration of Davy's safety lamp which was exhibited, its defects pointed out, and merits substantiated.* Dr. O'Shaughnessy explained the principles of the new galvanic battery, by Mullins.† The party then arose and proceeded to Mr. James Prinsep's department, who, by a small working model of a steam engine, traced the origin and described the progress of our knowledge in the power of steam and its application to mechanical purposes.

Mr. William Grant exhibited a contrivance of his own, which consisted of a little metallic drum, open for inspection at one side, turning upon an axis, between which and the diameter of the wheel are introduced metallic segments of a circle made to fit close and move round with ease, having but little friction. Between each pairs of these (two or three of which are sufficient) is introduced a moveable bolt, made like the latch of a door, catching at the end on one side and sliding back when pushed the contrary way. By this contrivance a constant and even motion is given in one direction by the introduction of steam between two of these segments just beyond the catch of the bolt arrives to be caught and detached like the first. A steam engine on this principle is deemed by the inventor extremely simple, and it is said that Mr. Grant had found it in England economise steam very much in comparison with other engines.

There were some beautiful specimens of drawings of mollusca by Cantor, and some fine oil paintings exhibited. Besides models of guns and carriages as attached to the artillery, at the three presidencies, we observed several models of semaphores and telegraphs. The stuffed birds from the Asiatic Society gave evidence of the increasing value of that society's museum. We cannot conclude our notice of His Lordship's interesting and instructive parties without conveying to him the expression of a general feeling apparently pervading the whole of those entertained, that a continuance of them will not only be promotive of the objects of science, but encourage also the mechanical arts. We are ourselves convinced that many have been excited to study and research on scientific subjects who never felt their importance before His Lordship gave the impulse: such ever has been, and ever will be, the mighty influence possessed by the ruling power. May a similar impulse be given by the heads of the governments at the other presidencies!

* We beg to refer those of our readers who are anxious of becoming thoroughly acquainted with this question, to the report of the committee of the House of Commons in our *Review*, page 181.

† This will be found fully described and illustrated by drawings at page 469.

ROADS AND PUBLIC WORKS IN INDIA.

The following is an abstract statement of all important public works which have been constructed at Madras and Bombay, or are at present in progress, such as canals, roads, &c. since the year 1813.

MADRAS.

1815 :

"The clearing of the drain passing through the esplanade, and the new street on the beach, were completed.

St. George's church on the Choultry Plain, also finished.

Construction of a bridge over the Mamdaroota river, between Cannanore and Cootaparamba; necessary to keep open the communication throughout the year, between the new road from the Western Ghauts and Cannanore.

1816 :

Improvements of the internal communication in Canara.

Construction of a bridge over the Paramboor nullah, and of a new road between the Black Town and the north-west approaches to Madras.

1817 :

Formation of wells in the vicinity of Madras.

A chapel built at Arcot capable of containing 300 persons; and one at Poonamalee of the same size.

1818 :

Construction of a stone bridge across the Madras river at the village of Chindrapettah, and sundry improvements connected therewith.

Erection of a new observatory.

St. Mary's church at Fort St. George reformed and repaired.

1819 :

Formation of a road in the Neilgherry Hills.

Repairs to the bridges across the Cauvery, at Seringapatam.

1820 :

Rebuilding of the lighthouse at the Presidency, completed.

1821;

Building a church for the Missionary Society.

Erection of a chapel at St. Thomas's Mount and of a church at Vepery.

Erection of a stone bulwark at Fort St. George, to protect the fort and the Black Town from the inroads of the sea.

1822 :

Erection of bridges at the island of Samoodra, in Coimbatoor.

The course of the river Vellaur straightened, with the view of securing a village.

Reconstruction of the bridge near St. Mary's burial ground, and of the one by the hospital gate of the Black Town.

Construction of a bridge over the swamp at Masulipatam; one half at the expense of government, the other at that of the inhabitants.

Scotch church (St. Andrew's) finished.

Completion of the stone bulwark, and addition of an iron railing.

1823 :

A new cut for the Votary nullah; also a new bridge, and other works connected therewith.

New laminating rooms for the mint.

1824 :

The opening of a canal at Chumnapore.

Several wells sunk in the northern division of Arcot for the purposes of irrigation.

Erection of a church at Tellicherry.

Excavating and removing the shoals in the Coorm river, from the burying-ground bridge to the Chepauk Bar; and thence to the N. W. angle of the burying ground wall at Fort St. George; also securing the bank opposite the centrical course of Clive's Canal near the burying-ground bridge, with a bulwark of stones.

Great road from Secunderabad to Masulipatam. (This work was continued until the year 1831, when, in consequence of its expense, the government limited themselves to the repair of such part of the road as might be impassable for wheel carriages.)

Great road from Madras through the Northern Circars, to the Bengal frontier. (In 1828 this work was discontinued, owing to the natural and local obstacles of its duration; that portion only of the road between Bezwarah and Ellore was to be completed.)

1825 :

Construction of a tunnel from the N. E. angle of Fort St. George to the sea, for the purpose of carrying off the filth from the Black Town.

1826 :

A bridge built across the Bonally nullah, the boundary of the British and Mysore territories, on the high road from Cannanore to Mysore and Madras.

Continuation of the excavation of the Coorm river, from the old Female Asylum to Anderson's Bridge.

A drain of two arches constructed on the west esplanade of Black Town near the Basin Bridge.

A bridge built over the Coorm river, and three roads leading to the bridge raised and new laid.

The road across the swamp from the fort to the pettah at Masulipatam, repaired.

1827 :

Erection of a monument, of a choultry and tank, at Goote, and the sinking of wells at Putteekondah, in honour of Sir T. Munro's memory : in progress.

Construction of a bridge across a nullah between Alliporam and Ganjam, in the main road through the Northern Circars.

Erection of a stone bridge over the Jacklee nullah, to secure a permanent communication between Kamptee and Nagpore.

1828:

Formation of a new road from the Wallajah bridge, to the bar on the south side of the beach at Madras, annexing safety railings and poles, and fortifying the bank of the river.

The mission church in the Black Town enlarged and improved.

The lighthouse in Fort St. George repaired.

Repairs made to Anderson's Bridge.

Construction of a causeway over the ditch at the drawbridge of the Mysore gateway, and one over that at the Bangalore gateway of the fort of Seringapatam.

Formation of a road from Madras to Bangalore. (This work has been completed to Poonamallee, but beyond that place the work has been restricted to the object of making it passable for carts and ordnance carriages.)

1829:

Military road through Coorg.

Construction of a cutwal's choultry at Jaulnah.

Erection of a bridge over the Wootary nullah, at Fort St. George.

The bar of the Coorm river partially opened at Chepauk, with a view of obtaining a supply of water from the sea by filtration.

Erection of a wall and cast-iron railing round the church at St. Thomas's Mount.

1830:

The construction of an anicut across the Kendalseroo river in Nellore.

The reform of a portion of the grand anicut in the bank of the Cavery at Trichinopoly.

The repair of the Bistee Ghaut in Canara.

BOMBAY.

1814:

The formation of a new road from Bancoote to Mundgaum.

Repair of the old docks; the completion of the slope in the dockyard for raising timber; the rebuilding the slip in the dockyard; the removal of the dam; and the forming an ordnance wharf.

Erection of a church at Surat: finished in 1823.

1815:

Formation of a road from Bandorah to Gorabunder.

1816:

Erection of a Scotch church: completed in 1818.

Construction of a chapel at Colabba authorized; is now in progress on a new and more simple plan than was at first designed.

1817:

Excavation of a tank at Bohur.

A chapel proposed to be substituted for an unoccupied barrack at Tannah, as a place of worship: completed by Government in 1826.

1820:

The Committee aqueduct for supplying the lower part of the Black Town with fresh water, and the Byculla tank, undertaken; finished in 1824.

Captain Hawkins's plan for draining the flats of Bombay by the Woorlee channel, adopted.

1821:

Rupees 20,000 expended by a native on a quarry near Byculla, to increase the supply of water; also a building for the accommodation of travellers; and a large tank at Bandreah in the island of Salsette: undertaken and sanctioned by order of Government.

A chapel at Poonah authorized in 1823.

1822:

A new wharf constructed at the port of Bombay.

1824:

Construction of a town hall undertaken: not yet completed.

1825:

Military road from the South Mahratta country to the coast.

A church erected at Dapoorlee; also churches in the east zillah north of the Myhee, and at Baroda, and a Roman Catholic chapel at Colabba.

Road from Nassick to Bhewndy: in progress.

1826:

Improvement of Sion causeway.

A chain suspension bridge over the Molla river applied for by Government; a wooden bridge at less cost substituted in 1830.

Construction of a new observatory sanctioned: finished in 1830.

Construction of a church at Mhow authorized.

1827:

Improvement of the Bhore Ghaut proposed; Captain Hughes's plan for constructing a road up it to Poona accepted: the work in progress.

A church built at Kirkhee.

Road from Malligaum to Surat, finished.

1828:

Construction of bungalows at Malabar Point, and formation of a botanical garden at Dapooree, undertaken: not yet completed.

1831 :
Sanction and subscription of Government for a church to be erected at Byculla by the inhabitants of Bombay."

The following are the surveys since 1813.

TRIANGULATION.

" Since the year 1814 the Meridional Arc has been extended from Daumergidda to Seronj by Colonel Lambton and Captain Everest, being in distance north and south six degrees of latitude.

A tract of country has also been triangulated in the Nizam's dominions, of the extent of about 30,000 square miles, by Colonel Lambton and Captain Everest.

A chain of triangles has been carried from Seronj to within 50 miles of Calcutta, a distance of about 12° of longitude, for the purpose of connecting that place with the Meridional Arc; the position of all the principal towns in the line of route has also been determined.

TRIGONOMETRICAL SURVEYS
which are connected by Triangulation with the Meridional Arc:

Madras Presidency :

	Square Miles.
Travancore and Cochin	10,000
South Coimbatoor	4,000
Dindigul	1,800
Trichinopoly	3,000
Koorg	2,200
Soonda and Balgy	2,400
Guntoor	5,000
Masulipatam	5,000
Rajahmundry and Elloor....	7,000
Vizagapatam...............	6,000
Part of the Nizam's dominions	13,000

Bombay Presidency :

The Deccan Survey as far as it is finished comprehends Dharwar; the rajah of Sattara's dominions; the rajah of Kolapore's dominions, &c.; the Northern and Southern Concan; part of Poonah, Bombay, &c.	50,000

Bengal Presidency ;

Bhopal	7,000
Bundelcund	16,000
The country between Bundelcund and Palamow......	9,000
Benares..................	3,000
The Dooab	2,500
Burdwan	4,000

TRIGONOMETRICAL SURVEYS ;
but which are not connected with the Meridional Arc ;

	Square Miles.
Mountainous Districts..	16,000
Ajmere	4,000
Hurriana	3,500
Part of the Sunderbunds	800
Assam	15,000
Sylhet	4,000
Munnipoor	5,000
Chittagong	4,000
Cuttack	6,000
Part of Kattywar and Gujerat	9,000
Bhoj	4,000
Kandeish	7,000

RECENT INVENTIONS MERITING THE ATTENTION OF THE PEOPLE OF INDIA.

The first of these is the successful construction of a steam carriage. Hancock's " automaton" is described in our present number and illustrated by a drawing. If such a one was constructed here, and suspension bridges were thrown over the different rivers, passengers might be conveyed with safety from Calcutta to Benares in 48 hours, and from this capital to Bombay in about three days and a half. It is said that Dr. Church has built a locomotive carriage, to which we alluded in our last, which is also considered fully effective and satisfactory ; the specifications of which, embracing many important matters, will appear in a future number. We have only to add that the fact is now established, that steam may be safely and economically employed as an effective substitute for horses, steam coaches being now employed in the ordinary transit of stage coaches on the turnpike roads in England. The next point to which we would call the attention of our readers is the great improvements in aerostation: one article will be found in our present number on this subject, which states, on grounds extremely plausible, that this country affords peculiar facilities for the management of balloons. In our last number it was shown that surveyors and architects could now with great facility take correct plans of noblemen's estates by ascending in a balloon.

BRETT'S AND THE FEVER HOSPITALS.

It is now nearly two years since it was projected to establish a Fever Hospital uniting the advantages of medical advice and of attention to the personal comforts of the native population of Calcutta. In May 1835, the subject was brought forward at a meeting of the governors of the Native Hospital, and subsequently a committee was appointed at a public meeting at the Town Hall, to carry the objects into execution. But the public are ignorant of the plans adopted and of what has been effected, saving the success of collecting Rs. 30,000 towards that laudable end. Thus, while the committee have been deliberating, many poor have suffered from such affections as tumours, cancers, stone, affections of the eye, and numerous other ills to which the human frame is subject. It probably never did occur to the committee that every day they postponed their determination there was some poor fellow-creature lingering in pain and agony; while many families were losing their only support by the death of a parent, a husband, or a friend.

Surely with such innumerable plans of other institutions before them in other countries and in other situations in India, founded by our benevolent medical brethren, there were not so many difficulties as to occasion this extraordinary procrastination. We must confess that it is unaccountable to us, and we can only ascribe the delay to what is asserted to be the case in all public committee attempts within the Mahratta ditch, to promote the public good, that there is something pervading this locality which tends to blight success on all occasions. Under these circumstances we are glad of an early opportunity of introducing to the notice of the public the effort of a mofussilite coming among us. In the short space of one month, Mr. Brett has effected by his laudable and spirited exertions what has been attempted and unaccomplished in nearly two years by the committee to whom we have alluded.

We present our readers with an account of a public meeting convened at the Town hall, which shows that Mr. Brett has succeeded beyond all doubt in establishing a Hospital, which has not only awakened a lively interest in the minds of the native community in its favour, and promoted extensive relief to the physical miseries of the poor, but we have no doubt will give an electric shock to every member of the Fever Committee to spur them on; telling them each and all to ponder no longer, but to work. The sentiments of Lord Auckland on Brett'sHospital will be read with pleasure as the testimony he bears to Mr. Brett's activity of mind will be encouraging others to emulate that bright example. What was it but a similar activity of mind which enabled Astley Cooper, John Bell, Liston, Louis, Dupuytren, &c. to raise surgery in Europe to a science.

His Lordship's high opinion and approbation of Mr. Brett's exertions is evident, and His Lordship's benevolent disposition to support what is good is also obvious. But he thinks that Mr. Brett's propositions do not possess more merit than other plans which have been projected. We would, with deference, observe however, that there is a wide difference between a *projected* plan, and one actually brought into operation by individual exertion. There is a great difference between deliberation for years about doing good and *at once* setting about that good!—Much must be said also for tried professional attainments, for experience, for ingenuity in all the circumstantials which are indispensable to render an enterprize successful in its issue? Much is to be said also for qualifications in the native languages. It is by these means that Mr. Brett has obtained that knowledge of the customs, habits, prejudices, and so forth of the natives, which, united to a benevolent deportment and successful practice in all departments of his profession, have enabled him to obtain that confidence in

so short a time, and to establish that celebrity of his hospital which now exists, so that patients come actually from several marches distant for relief. Mr. Brett's success, *alone*, owing to his extraordinary zeal, is sufficient to entitle his measures to the highest support, patronage, and confidence of the exalted head of the Government.

A VISIT TO MR. CROSSE, AT HIS RESIDENCE ON THE QUANTOCK HILLS, SOMERSET.

We extract a valuable communication from Sir R. Phillips to the scientific institution lately established at Brighton, descriptive of a visit to the celebrated mineralogist Mr. Crosse. The imperfect notices hitherto given of Mr. Crosse's extraordinary experiments will render the present communication valuable, as it will excite the wonder of our scientific friends.

"On reaching the handsome mansion of Mr. Crosse, situated in an undulating park, studded with trees of great bulk and age, I was received with much politeness, and found that I was the first visitor from Bristol. As I was preparing to retain my conveyance to convey me back to Bridgewater, I was requested to return it, and pressed to stay to dinner and take a bed. Breakfast being well served, Mr. Crosse then conducted me into a large and lofty apartment, built for a music-room, with a capital organ in the gallery, but I could look at nothing but the 7 or 8 tables which filled the area of the room, covered with extensive voltaic batteries of all forms, sizes, and extents. They resembled battalions of soldiers in exact rank and file, and seemed innumerable. They were in many forms, some in porcelain troughs of the usual construction, some like the *couronnes des tasses*, others cylindrical, some in pairs of glass vessels, with double, metallic cylinders; besides them, others of glass jars, with stripes of copper and zinc. Altogether there were 500 voltaic pairs at work in this great room, and in other rooms about 500 ready for new experiments. It seemed like a great magazine for voltaic purposes.

"There are also two arge workshops, with furnaces, tools, and implements of all description, as much as would load two or three waggons.

"In the great room there is also a very large electrical machine, with a 20-inch cylinder, and a smaller one, and in several cases all the apparatus in perfect condition, as described in the best books on electricity. The prime conductor stood on glass legs, two feet high, and there was a medical discharger on a glass leg of five feet. Nothing could be in finer order, and no private electrician in the world could, perhaps, show a greater variety, both for experiments and amusement.

"Beneath the mahogany cover of a table, on which stood the prime conductor, &c., was enclosed a magnificent battery of 50 jars, combining 73 square feet of coating. Its construction, by Cuthbertson, was in all respects most perfect. To charge it required 250 vigorous turns of the wheel, and its discharge made a report as load as a blunderbuss. It fuses and disperses wires of various metals; and the walls of the apartment are covered with framed impressions of the radiations from the explosion taken at sundry periods. Mr. Crosse struck one while I was present, and he has promised me one as an electrical curiosity and a memento of my visit.

"But Mr. Crosse's greatest electrical curiosity was his apparatus for measuring, collecting, and operating with, atmospheric electricity. He collects it by wires, of the 16th of an inch, extended from elevated poles to poles, or from trees to trees, in his grounds and park. The wires are insulated by means of glass tubes well contrived for the purpose. At present he has about a quarter of a mile of wire spread abroad, and in general about the third of a mile. A French gentleman had reported to the section at Bristol, that the wires extended twenty miles, filling the entire neighbourhood with thunder and lightning, to the great terror of the peasantry, who, in consequence left Mr. Crosse in the free enjoyment of his game and rabbits. This exaggeration Mr. Crosse laughed at most heartily, though he acknowledged that he knew that no small terror prevailed in regard to him and his experiments.

"The wires are connected with an apparatus in a window of his organ gallery, which may be detached at pleasure, when too violent, by simply turning an insulated lever; but in moderate strength it may be conducted to a ball suspended over the great battery, which, connected with it, is charged rapidly, and is then discharged by means of an universal discharger. He told me that sometimes the current was so great as to charge and discharge the great battery

20 times in a minute, with reports as loud as cannon, which, being continuous, were so terrible to strangers that they always fled, while every one expected the destruction of himself and premises. He was, however, he said, used to it, and knew how to manage and control it; but when it got into a passion, he coolly turned his insulating lever, and conducted the lightning into the ground. It was a damp day, and we regretted that our courage could not be put to the test.

"Every thing about this part of Mr. Crosse's apparatus is perfect, and much of it his own contrivance, for he is clever in all mechanical arrangements, and has been unwearied in his application, almost night and day, for 30 years past. I learned, too, that in the purchase and fitting of his apparatus, he has expended nearly £3,000, although in most cases he is his own manipulator, carpenter, smith, copper-smith, &c.

"About 12, Professor Sedgwick arrived, and in the afternoon one or two others, besides seven or eight gentlemen of the neighbourhood, who had been invited to meet us at dinner, for Mr. Crosse unites to the rank of Esquire that of a country magistrate, in the duties of which he is respected alike for his humanity to the poor, and for his liberal opinions in politics. Mrs. Crosse I had not the pleasure of seeing, one of the sons being ill. Mr. Crosse himself was educated at Oxford, and his second son holds the living of Broomfield. He is master of all his father's experiments, and, in spite of the complaints of an Oxford education, I found him to be a very expert mathematician, well read, and variously accomplished. At seven o'clock we enjoyed a dinner as well served as I ever saw any state-dinner in London, and beds being reserved for Professor Sedgwick and myself, we next morning renewed our survey, previous to fresh arrivals; and I took notes of every thing connected with his aqueous voltaic batteries, in the following order, errors excepted:—

"1. A battery of 100 pairs, of 25 square inches, charged like all the rest with water, operating on cups containing 1 oz. of carbonate of barytes and powdered sulphate of alumine intended to form sulphate of barytes at the positive pole and crystals of alumine at the negative.

"2. A battery of 11 cylindrical pairs, 12 inches by 4. This, by operating six months on fluate of silver, had produced large hexahedral crystals at the negative pole, and crystals of silica and chalcedony at the positive.

"3. A battery of 100 pairs, of 4 square inches, operating on slate 832, and platina 3, to produce hexagonal crystals at the positive pole.

"4. A battery of 100 pairs, 5 inches square, operating on nitrate of silver and copper, to produce malachite at the positive pole; at the negative pole, crystals already appear with decided angles and faces.

"5. A battery of 16 pairs, of 2 inches, in small glass jars, acting on a weak solution of nitrate of silver, and already producing a compact vegetation of native silver.

6. "A battery, esteemed his best, of 813 pairs, 5 inches, insulated on glass plates on deal bars, coated with cement, and so slightly oxydated by water as to require cleaning but once or twice a year, by pumping on them. I felt the effect of 458 pairs in careless order and imperfectly liquidated, and they gave only some tinglings, but this power in a few weeks produces decided effects.

"7. A battery of 12 pairs, 25 inches zinc and 36 copper, charged 2 months before with water, and acting on a solution of nitrate of silver, poured on green bottle-glass coarsely powdered. It had already produced a vegetation of silver at the positive pole.

"8. A battery of 159 galley-pots, with semi-circular plates of 1½ inch radius placed on glass plates, and acting for five months, through a small piece of Bridgewater porous brick, on a solution of silex and potash. I saw at the pole small crystals of quartz.

"9. A battery of 30 pairs, similar to No. 8, acting since July 27, on a mixture, in a mortar, of sulphate of lead, of white oxide, of antimony, of sulphate of copper, and of green sulphate of iron (205 grains), and three times the whole of green bottle-glass (615 grains). The result has been in five weeks, a precipitation, on the negative wire, of pure copper in two days, and crystallized iron pyrites in four days. It had been expected to produce sulphurets of lead, copper, and antimony, by depriving the sulphates of their oxygen. On August 10th and 28th, 25 grains and 40 grains of sulphate of iron were added.

"10. A battery of 5 jars, with plates of different metals, as two copper and platina, one of lead and lead, and one silver and iron, and one copper and lead.—Experimental.

"11, 12, and 13. About 200 pairs, in three batteries, working in a dark room, of which I took no note.

"While I was an inmate with Mr Crosse, we had various conversations about the

power which he employed. I had in some degree anticipated his *début* by hazarding in the last edition of my 'Million of Facts,' 1835, an assertion that, inasmuch as metals are found in only a mixed or confused state in different rocks, among which a galvanic action on air or water would necessarily arise, long time would generate the compound matrices of metals; but I did not regard this public anticipation as any inference with his original merits, and I was deeply penetrated by the view of his labours, and the expense and zeal with which he had prosecuted his experiments. Yet he had a round conductor for a minimum of power, instead of a combination of flat or parallel ones for a maximum. And he could not help talking about the fluid, and some other fancies of the elder electricians, who invented their doctrines before it was suspected, that air was a compound, and that such active powers as oxygen, nitrogen, hydrogen, and their definite numerical co-mixtures, conferred mechanical character on the most refined operations of nature.

"He instructed me in the fact that his batteries performed four times the duty in those hours in the morning, from 7 to 11, when the great laboratory of nature is evolving the most oxygen, than in the same period in the evening, when we may imagine the contrary effect takes place. He considered the air as so non-electric in damp weather, that no plate of air, lying between the coating of a cloud and the earth, could then be disturbed, and he stated to me as a general fact that the earth is always positively electrified.

"On my part I enlarged to him and his son on the universality of matter and motion in producing all material phenomena, independently of the whimsical powers invented in ages when he would have been burnt for a magician, and in this way I endeavoured to return the various information which he had so unreservedly imparted to me. I impressed on him that all this creative energy of atom was merely a display of developments by the great motions of the earth as they affect the excitable parts of different solid bodies; the results of which are necessarily regular, and their ultimate laws of re-action and combination also regular, so as to produce that universal harmony which surprizes beings who, in eternal time, live and observe within only a unit of time. Hence that terrestrial galvanism arising from the operations of the internal frictions and varied pressures called heat; hence those factious productions of metallic matrices and crystalline forms resulting from refined and subtle actions which confer electrical and galvanic effects, where different substances are proximately opposed; hence magnetism itself tangentally displayed as a resultant of terrestrial currents of electricity: hence the fluctuations of the phenomena from obliquity of the axis of rotation which, in regard to the axis of the orbit, generates two variable directions of massive pressure; hence, in fine, the wisdom displayed by Mr. Crosse in resorting to the *modus operandi* of nature in his attempts to imitate her most curious productions.

"Observing that continual fresh arrivals rendered it ineligible for me to prolong my visit, I proceeded to Taunton, a distance of six or seven miles, the nearest place at which a stranger can meet with public accommodation."—*Lancet, Oct.* 1836.

PUBLIC MEETING AT THE TOWN HALL.

Saturday, 11th March, 1837.

The Venerable Archdeacon Dealtry was called to the chair.

On the opening of the proceedings the chairman observed that it would have been as well in the first instance to have submitted the proposition for the establishment of Mr. Brett's Hospital to the District Charitable Committee and to have solicited its support, which no doubt would have been granted on the great utility of the Hospital being fully proved to that committee. He was himself ready to give it his most strenuous support. Mr. Drummond observed that a committee had been sitting for sometime past for the purpose of establishing a fever hospital, for which public contributions had been obtained as well as the co-operation of the Government, and he thought the proposition for establishing another hospital premature and likely to interfere with the one projected. He had the sentiments of Lord Auckland on the subject, which he would read to the meeting. (Here Mr. Drummond read the following letter from his Lordship.)

"I will not head a subscription, as seems to be desired, for a General Hospital, though

I am willing, by a small donation to the establishment in the Chitpore Road, to afford to Dr. Brett some assistance in his commendable attempt to give medical and surgical relief to the poorer classes of the inhabitants of Calcutta.

I see nothing in his plan, beyond the activity of his own personal exertions to distinguish it from that of other institutions established or projected for the same purposes; and until the information which I hope shortly to see collected in regard to them shall be fully before me, I would not pledge my opinion further than I have already done upon the objects of this kind to which support may be most advantageously given."

Mr. Brett believed it was an acknowledged principle of the Government not to interfere with such establishments, but leave them in the hands of the public. The object was therefore to lay before the meeting documents proving the utility of the hospital, and to seek the public sanction.

The chairman desired the prospectus to be read.

Mr. Corbyn rose and said that, when Mr. Brett first instituted his hospital, he had taken the same views of the subject as those alluded to by Mr. Drummond, that it would interfere with the plan of the projected fever hospital; but when he visited the hospital, and saw the immense extent of good done, and the popularity it had attained among the native community, his sentiments were altogether changed, nor did he hesitate to say that it would be cruel to the afflicted poor to shut the doors of such an institution where so many had obtained relief; when he (Mr. Corbyn) remembered the slow pace with which the Fever Committee moved, he thought it would be cruel to wait for any measures from them. He hoped however, when that committee witnessed the great public benefit derived from this hospital, the confidence of the people in it, and the transcendant abilities of Mr. Brett, they would be the first to step forward to bring it within their plan and give it their support. When Mr. Corbyn considered that the only supporters of the hospital were two benevolent individuals, Gourmohun Dey and Mr. Manuk, whom he had the happiness to see at the meeting, he dreaded lest this valuable institution should cease for want of contributions, and it was therefore the imperative duty of those present to use every exertion in their power to obtain public countenance and support.

Mr. Brett disclaimed all intention of interfering with other institutions. There was an immense field of good and much had already been done. Would the public now listen to the calls of the afflicted and come forward with its support. He (Mr. Brett) considered that the most effectual mode of proceeding was that of shewing the extent of benefit to be derived, by actual experiment, as was demonstrated in this instance, and then to call upon the benevolent public for its support? He would be delighted if the Fever Hospital Committee would take up the institution; all he wished was that, as the hospital embraced all the objects which the Fever Hospital Committee had in view, and more, and as it was established on the only principles which were calculated to insure the confidence of the natives, that the Fever Hospital Committee should call it their own and adopt it. It was not *his* hospital but the public's. He totally disclaimed all personal interest in the affair. Mr. Brett was fully aware of the benevolent intentions of Lord Auckland, as conveyed by Dr. Drummond: he knew also that the present meeting, and Dr. Drummond amongst the rest, were unanimous in one object, viz. benevolence. He also was aware of the Archdeacon's good intention in having the subject brought before the District Charitable Committee, but still he sought this opportunity for obtaining the public sanction and support to his efforts.

Rev. Mr. Boaz observed it was lamentable to witness the opposition with which genius had to contend, but that it would always ultimately gain its ascendency, and triumph.

over all obstacles. He considered that the offer which had been made by Dr. Brett of his hospital to the Fever Hospital Committee would be one of the greatest boons which had been conferred on that institution. Mr. Boaz had been struck very forcibly with two important points in the success of this undertaking, viz. first the site on which it was to be founded, and secondly securing the confidence of the people; both these important objects had been obtained in Dr. Brett's case. The only objection which had been placed before the meeting to its establishment was its interference with the projected fever hospital. This objection should not in his opinion outweigh the benefit of the two important objects already attained; besides, that institution had now been fifteen months before the public without any practical good resulting, nor was it so popular as could be desired, owing to this remissness with the native community, in comfirmation of which assertion he would appeal to the native gentleman present.

Gourmohun Dey nodded assent.

Mr. Jacob had visited Mr. Brett's hospital: he thought it had been established in the fittest site possible for such an institution. He had been in various parts of Calcutta and had made a point of enquiring of the natives their opinion of the institution, and the reply invariably given was that it was a most valuable institution. He thought it should be established without delay, and that because it was promoting extensive good.

The following resolutions were then put and unanimously adopted.

That this meeting highly approves of the generous, disinterested, and successful labours of Dr. Brett in his endeavours to relieve the miseries of the indigent native population of Calcutta, and in his efforts to establish a native hospital.

2. That while this meeting is impressed with the importance of such an institution, remembering that a similar one has been some time in contemplation and may soon be matured under the auspices of the District Charitable Society, it recommends that the subject be brought under consideration of that Society before any further steps be taken for the permanent establishment of Dr. Brett's institution.

3. In the meanwhile, to prevent the possibility of the natives being deprived of the advantages of the present institution, the meeting recommends it as an object worthy the confidence and support of the public, that subscriptions and donations be solicited to carry on its operation.

The thanks of the meeting were then voted to the chairman, for his conduct in the chair.

Subscriptions and donations will be cheerfully received by the Venerable the Archdeacon, and Reverend T. Boaz, Union Chapel, Durrumtollah, by Messrs. Corbyn, Jacob, and Brett, H. Manuk, Esq., and Baboo Gourmohun Dey.

J. LANGSTAFF, ESQUIRE.

1st Member, Medical Board.

It is said that Mr. Langstaff, in consequence of recent indisposition, will proceed forthwith to the isle of France and New South Wales, whence, it is probable, he will return to Europe.

PROGRESS OF SCIENCE,

AS APPLICABLE TO THE ARTS AND MANUFACTURES; TO COMMERCE AND TO AGRICULTURE.

IMPROVED MODES OF PREPARING CHARCOAL.

In consequence of the great waste of charcoal, in the usual mode of preparation, and the entire loss of the volatile matter, two modes have been contrived, in either of which the quantity of charcoal obtained may be almost as large as in iron cylinders, and the volatile matters may be collected.

The first of these is best suited to the hard woods which contain but little resinous matter. This operation is performed in a kiln of the shape of a cylinder, or rather a truncated cone whose larger base is uppermost. It may be built of sods or tenacious earth above the natural surface of the soil, but may be more conveniently excavated to such a depth that the earth thrown out may serve to form the upper part of the enclosure. In the only instance in which we have seen it employed in this country, namely, at the West Point Foundry, the excavation is lined with brick.

In order to admit air to the kiln, when made by excavation, for the purpose of maintaining the combustion, tubes of earthenware or cast iron are carried down from the surface of the ground to the bottom of the excavation: these lie behind the lining, and are either passed through it near the bottom, or enter small brick vaults, which communicate with the interior of the kiln. The kiln may be closed at top by a cover made of sheet iron, to support which, when the lining is not of brick, a ring of bricks must be placed around the top of the excavation. The cover must extend on all sides three or four inches beyond the opening of the kiln, in order to have a sufficient support. In this cover there are several openings, one at the centre, the others near the circumference. Through each of these a short tube or flue of sheet iron passes, and the several tubes are furnished with stoppers of iron.

The size described by Dumas is ten feet (French) in diameter, and nine feet deep. The central tube is nine inches in diameter. The number of these at the circumference is four, each four inches in diameter.

That used at the West Point Foundry is twelve feet in diameter and nine feet deep.

In order to condense the volatile matter, one opening is made in the lining near the top of the kiln, to which a tube of cast iron or earthenware is applied. This tube communicates with a small chamber built of brick, about eighteen inches long, a foot in width, and fifteen inches high, entering about the middle of its height. From the top of this chamber proceeds a pipe of sheet iron, which, after rising vertically four or five feet, assumes a horizontal direction for about fifteen feet more; at this distance there is no fear of fire, and the rest of the pipe may be of wood. The extension of the pipe communicates with a condensing apparatus, on the principle of Woolf, but which may be formed of common barrels.

In charging the kiln with wood, a post whose height is equal to the depth of the excavation is set up in the middle, and supported in its place by a heap of fragments of charcoal. A number of the larger logs are chosen and laid on the bottom of the kiln in such a manner as to form radiating flues, terminating at the places when the air tubes pass through the lining. Across these a horizontal layer of logs is laid. The radiating logs must neither touch the post or the lining of the kiln; the secondary layers extend from the one to the other. Layers are then placed in succession in such a manner as to leave as little empty space as possible, particularly near the circumference until the kiln is filled. The kiln having been charged, the post is drawn out of the middle, the cover set in its place, and coated to the depth of not less than two inches with dry earth.

The stoppers being withdrawn from the flues in the cover, lighted charcoal is poured down through the middle tube; this falls through the space left by the post, to the heap of charcoal by which it was steadied, and sets it on fire. The central flue is then tightly closed, in order that the draught may be directed towards the outside of the mass of wood. In order to make the joint of the stopper tight, it is luted with plastic clay. The other flues begin to discharge smoke, which is surounded by flame. As soon as the flame ceases to have a blue colour and becomes white and clouded, the flues have their stoppers loosely applied to them, and the openings of the descending air tubes are diminished. The draught will thus be directed to the condensing apparatus. But if the collection of the acid be not intended, the tubes in the cover are but partially closed. The combustion may be regulated within the kiln by the air tubes and those in the cover. Thus, too rapid an action in any one part may be checked by completely closing the several air tubes and the opposite flue; and if it be too slow, these must be opened as far as possible until the action be restored.

For a kiln ten by nine, the operation occupies from sixty to eighty hours, and is known to be complete when the upper layer of wood appears to be incandescent; when this has taken place, the stoppers of all the openings except that of the central flue are removed for a short time, and a quantity of hydrogen will be expelled, whch, if it does not injure the quantity of charcoal, would render it less saleable. As soon as the peculiar flame of hydrogen ceases, all the opening, both of the air tubes and flues, must be closed by shutting their stoppers with clay, and covering them with caps of sheet iron containing clay. The dry earth is removed from the cover, and it is plastered with earth mixed with water. The charcoal thus shut up will take sixty to eighty hours to cool.

A plan and section of this description of kiln is represented in plate viii, figs. 1, 2, 3, 4, and 5.

Fig. 1, and 2, being plan and section of one formed in an excavation, and

Fig. 3, and 4, of one built above ground.

Fig. 5, cover of sheet iron applicable to either.

A. Interior of kiln.

B. Wall, or lining of earth.

C. Chamber in which the tar may be condensed.

d. Pipe leading to the condenser for pyroligneous acids.

e, *e*, *e*. Air-vaults.

f, *f*, *f*. Openings by which the external air is admitted.

At the Bennington furnace,a kiln of similar form was constructed of brick, above the level of the ground, and covered by a permanent dome of brick. In the wall a door was left for the introduction of the wood, and this was subsequently bricked up. Vents were formed by leaving bricks loose in the wall, and when the process was complete, the fire was extinguished by means of water. An unexpected benefit was found to arise from the latter operation; for the coal, becoming charged with aqueous vapour, was as fit for immediate use, as that which had been prepared for several months.

It is estimated that the product of kilns of this kind in France, is about 25 per cent more than in a coal-pit. The experiment at the West Point Foundry was more advantageous, the product having 50 per cent. more than was obtained in the usual method. In France the main object was the pyrolignous acid, which at West Point was neglected; and this difference in the object will account for the difference in the results. The mode of placing the wood was also different; the French using that which has been described above, while at the West Point it was placed vertically.

In the pine forests of Sweden, an apparatus better suited to the collection of the turpentine that kind of wood furnishes, has been invented by Schwartz. This kiln is composed of a vault, built of brick or silicious stone laid in a mixture of clay and sand. Common mortar must not be used, as it would not only be effected by the heat, but would be completely destroyed by the pyrolignous acid. The vault is closed at each end by a vertical wall of the same kind of masonry. The floor of the kiln is of earth, and has the figure of two planes slightly inclined, and meeting in a gutter in the middle of the longer sides of the vault. In each end wall are two fire places, and in one of them are four openings for introducing the wood and withdrawing the charcoal. The smoke and vapour are carried off by flues of cast iron at the level of the ground, and proceeding from the middle of the larger sides of the vault; these minate in channels where the vapour is condensed, and which convey the smoke to two vertical chimneys. A section of this kiln is represented in fig. 6.

The advantage of this arrangment is, that no air can enter the kiln without passing through the fire-places which are kept full of burning fuel; and that the fuel which is best suited for this purpose (small branches and twigs), is useless in making charcoal. In placing the wood, the pieces are laid parallel to the largest sides of the vault, and in such manner as to leave as little space as possible except in the neighbourhood of the flues, which must be kept free for the escape of smoke and vapour. Two days are sufficient to convert the wood into charcoal, and the end of the process is known by the appearance of the blue flame of carburetted hydrogen at the chimneys. The whole of the openings are then closed, and luted with clay.

At the end of two days, two holes, left for the purpose in the arch of the vault, but which have during the process been carefully closed, are opened, and water thrown in to cool the charcoal; these holes are then closed again. At the end of three or four days more, one of the doors in the end wall is opened, and more water thrown in; but the charcoal will not be ready to be removed, until all the external parts of the apparatus have become as cold as the surrounding air.

This kind of furnace has been much used in Europe, and the quantity of charcoal obtained is one-third more than is obtained from coal-pits. The turpentine and acetic acid are also saved, which in other cases are lost. There can be no doubt that it might be introduced to advantage in those parts of our country where iron is manufactured by means of charcoal prepared from pine wood.

In using kilns of either description, it becomes a matter of calculation whether it be cheaper to manufacture the charcoal in the woods in the usual nanner, or to carry the wood to the kiln. The weight of the charcoal to be transported will be only seventeen parts of that of the wood; while the charcoal obtained by the kilns will be certainly one-third more than that procured from the pits. It must therefore appear that the value of the additional charcoal shall be at least equivalent to the cost of transporting the wood to the kiln. It is also to be remarked, that charcoal prepared on the spot where it is to be used is better than that which has here been handled and carried over rough roads, and that all waste is avoided.—*Mechanics' Magazine.*

MR. HANCOCK'S STEAM-CARRIAGE "AUTOMATON," AND STATEMENT OF HIS LATE TRAFFIC BETWEEN THE BANK AND PADDINGTON.

On our front page* we present our readers with an engraving of the "Automaton," the last steam-carriage built by Mr. Hancock. One or other of this gentleman's carriages have been travelling, without intermission, since the 11th of May last. That steam-locomotion on common roads is both practicable and safe to the passengers and the public, he has proved; it remains for him to show (which it will be seen by the following letter, containing a statement of his late performances, he promises shortly to do), that his travelling has been economical, so as to return a fair profit to any capitalist who may embark his money in a speculation of the kind.

Mr. Hancock is now the only engineer with a steam-carriage on any road. Sir Charles Dance, Colonel Maceroni, Dr. Church, Messrs. Ogle, Summers, Squire, Russel, Redmund, Heaton, Maudsley, Frazer, and a host of others—where are they? Echo answers—"Where!" Strange to say, however, we see steam-carriage companies advertised, whose engineers have either never yet built a

* See plate viii, fig. 7.

ncock's new Steam Carriage "Automaton!"

Fig 7

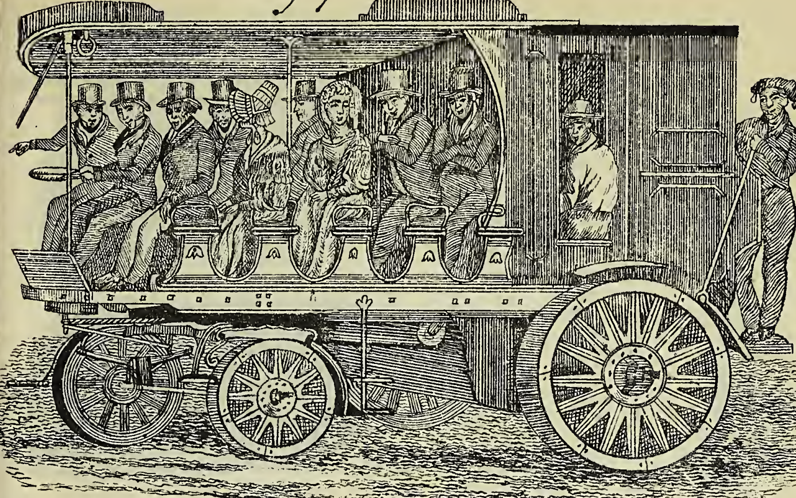


Fig 1

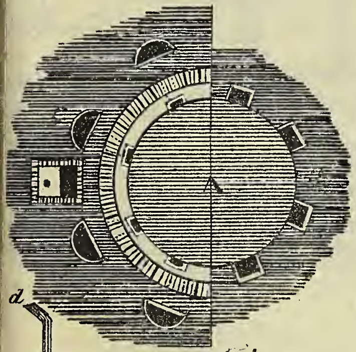


Fig 3

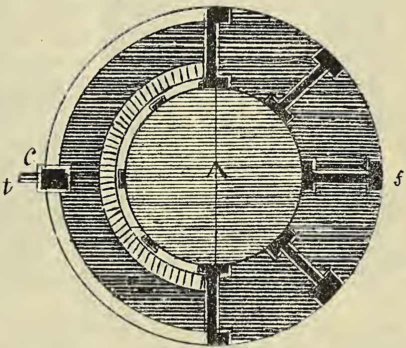


Fig 2

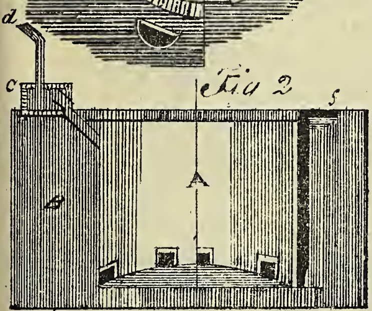


Fig 4

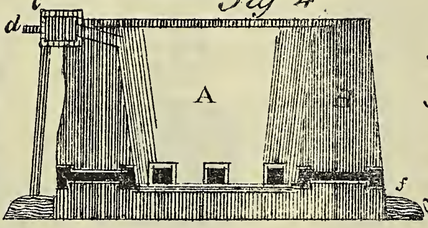
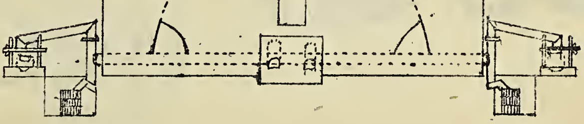
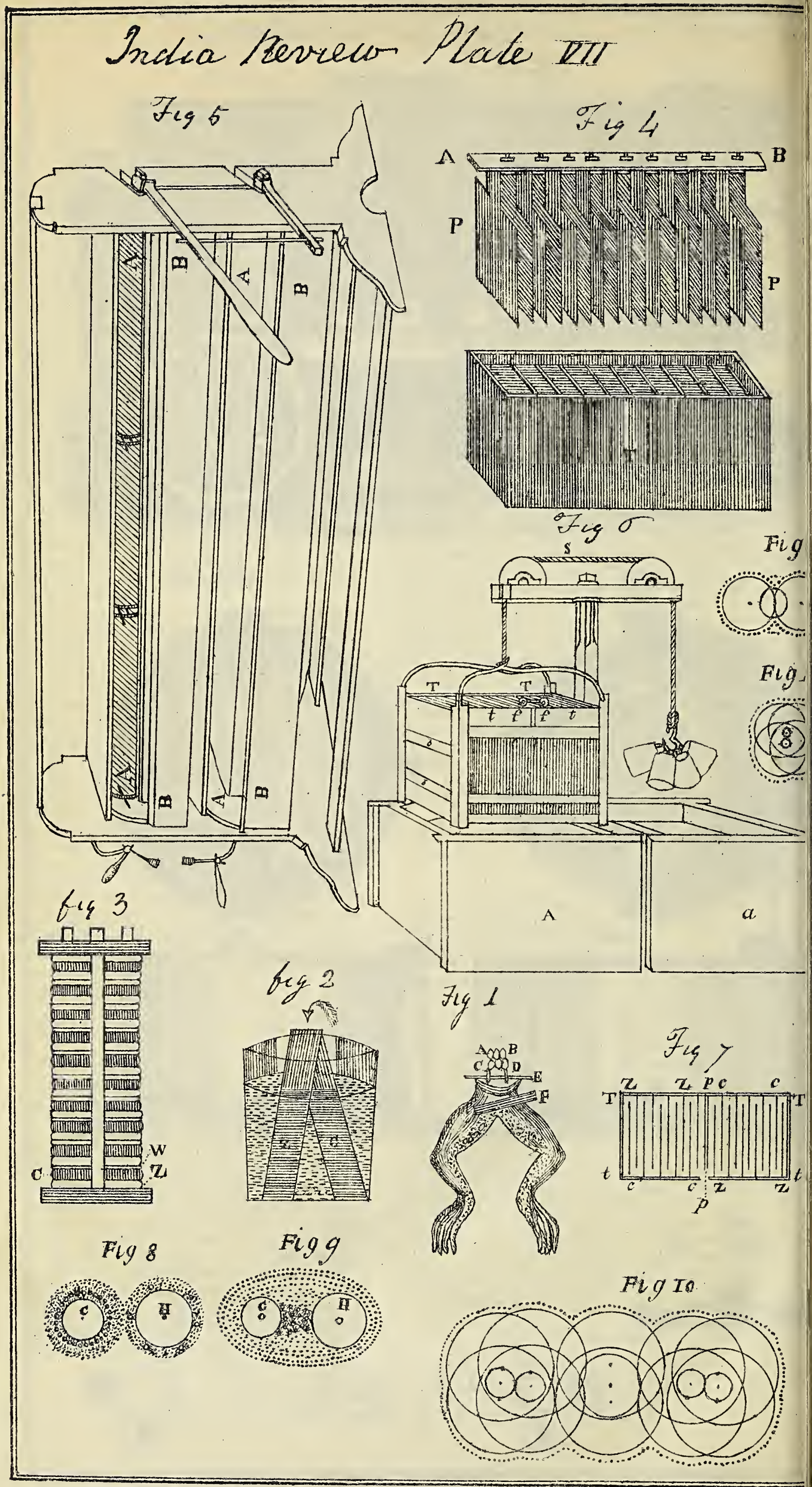


Fig 6

Fig 5



Improved modes of Burning Charcoal


India Review Plate VII
Fig 5
Fig 4
A
B
P
P
Fig 6
S
T
T
t f f t
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a
Fig
Fig
fig 3
W
Z
C
fig 2
Fig 1
A B
C D
E
F
Fig 7
Z Z P C C
T T
t t
c c Z Z
p
Fig 8
C H
Fig 9
C H
Fig 10

carriage, or whose carriages when built have never stirred out of the factory yard.

Sir,—Tuesday evening, the 20th inst., completed twenty weeks' continued running on the Stratford, Islington, and Paddington roads, during this year, and I beg to hand you as faithful an account as I can of the performances of my carriages.

Since the last notice in your Magazine, a new carriage, the "Automaton," has been brought upon the road, the only difference between which and those preceding it is, that the engines are of greater power (having cylinders of 12 inches diameter, whilst those of the others are of 9 inches), and the carriage altogether of larger dimensions than the others, it having seats for 22, whilst they are only calculated for 14 passengers. It is an open carriage like the "Infant;" and although only calculated for the accommodation of 22 passengers, it has carried 30 at one time, and would then have surplus power to draw an omnibus or other carriage containing 18 more passengers, without any material diminution of speed; its general rate of travelling is from 12 to 15 miles per hour. On one occasion it performed (when put upon the top of its speed, loaded with 20 full-grown persons) a mile on the Bowroad, at the rate of 21 miles per hour.

The first time the "Automaton" was brought upon the road (the latter end of July) it conveyed a party to Romford, and back, at the rate of 10 to 12 miles per hour, without the least interruption or deviation in its working, although it was the first, or as I may call it, the day of proving; nor has it required any repairs whatever to this time.

After this digression in describing the "Automaton," I will return to the actual work done on the public roads and streets of the metropolis during the last twenty weeks, or five months, in as concise a manner as I can :—

The miles run, about	4,200
Passengers carried	12,761
Trips—City to Islington, and back .	525
Do. .. Paddington do. ..	143
Do. .. Stratford do. ..	44
Supposing the carriage had always been full, the passengers carried would have been	20,420
Average time a carriage has run each day - 5 hours, 17½ minutes.	

An exact account of the number of times that the carriages have gone through the City in their journeys has not been kept, but I should suppose that it must be more than 200. For the last five weeks a carriage has been at the Bank twice a day, viz. between the hours of 2 and 3 and 5 and 6 in the afternoon.

It was on one of the morning trips from Stratford to the Bank, through the City, that the steamer became entangled with a waggon at Aldgate; and which, I am happy to say, is the only accident worth recording. The shafts of the waggon were swung by the the contact against the projecting front of a shop; the damage done was trifling, and occasioned by the wheels of the steam carriage having got into the iron gutter, and out of which it is not an easy thing to gain the fair surface of the street with any ordinary carriage in so confined a situation as that part of Aldgate in which the accident happened; and it should be observed, that this occurred in making way for another carriage passing at the time.

I will now give you an account of all other accidents (which have all happened to the damage of the steamers themselves) viz. the chain pulley of the "Enterprise" once broke on the axletree; the same occurred once to the "Infant," which were permanently and immediately replaced by castings from the same pattern, with a greater thickness of metal, and which have since stood well.

The severe test afforded by the state of the City Road and onward to Paddington, caused these failures; for the pulleys had stood well on other roads, for many miles.

Another accident was a hind-wheel of the "Erin" coming off in the New Street, near the Bank, on which occasion the carriage sunk only about eight or nine inches, in consequence of the frame-work of the machinery taking the ground; and so little was the coach thrown out of the level, that the inside passengers were surprised when informed that the wheel was off. The concluding accident was by the steerage chain of the "Infant" being too slight, and breaking at Islington, when the carriage turning short round, with one of the fore wheels against the curb, the wheel was broken. This wheel was an old one, of much slighter construction than I now make them.

In the early part of the five months' running, the close-bodied carriages, "Erin" and "Enterprise" were about equally employed—in the latter part, and to the present time, in consequence of the fine weather, the open carriages "Infant" and "Automaton" have been running.

I have occasionally examined the boilers and engines of all the carriages, and found that the engines have in most parts actually improved, whilst the boilers and fire-places have suffered a deterioration, less than could have been expected, from the use they have undergone.

It may be remarked, that both boilers and machinery are suspended on well acting springs, and which account for the state of all the parts being so well preserved. Some of the boilers have been in use for two or three years.

There have been consumed in the before-mentioned traffic, 55 chaldrons of coke, which is equal to 79 miles per chaldron, or about 24½*d.* per mile for fuel; but this on long journeys would be much reduced by the application of the moveable fire-place, patented by me about three years ago, as our greatest expenditure of coke in these short journeys is in lowering and again raising the fire.

I cannot conclude without noticing with gratitude the general civility and attention which I have met with, and my pleasure in discovering that the antipathies which existed in the earlier part of my career are gradually subsiding, and that in fact, I never now meet with incivility expecting with a few carters or draymen, who consider the introduction of steam-carriages as an infringement upon the old-established use of horse-flesh.

Years of practice have now put all doubts of the economy, safety, and superiority of steam travelling on common roads at rest, when compared with horse travelling; and I have now in preparation calculations founded upon actual practice, which, when published, will prove that steam locomotion on common roads is not unworthy of the attention of the capitalist, though the reverse has been disseminated rather widely of late by parties who do not desire that this branch of improvement should prosper against the interests of themselves.

After twelve years of incessant labour in steam-locomotion,

Your obedient servant,

WALTER HANCOCK.

Stratford, Sept. 22. 1836.

Mechanics Magazine, Sept. 1836.

NEW SYSTEM OF GEOLOGY.

Sir,—I have read with much interest the various articles upon the "Electrical Theory of the Universe," and I am glad to find, from Kinclaven's last letter on the subject, that no great danger is to be apprehended of this earth or any of the other planets being "whirled into the body of the sun." But, Mr. Editor, there is another new system of geology which is now making some noise, the following account of which I copy from the catalogue for the present year of the Society for the Illustration and Encouragement of Practical Science, Adelaide-street:—

"No. 10 p. 46.—A Geological Globe, presented by Sir John Byerley.

"This globe, the invention of which is due to M. Guesney, of Constance, in Normandy, is intended to show the changes on the earth's surface, produced by the precession of the equinoxes, whereby the pole of the equator revolves round that of the ecliptic in 25,920 years (Delambre).

"The fixed circle is the ecliptic, or that line to which the sun would be vertical in the course of a tropical year, were there no diurnal motion. The moveable circle represents the equator, preserving the same angle with the ecliptic by cutting it in different points at every succeeding equinox; by which means the pole of the earth passes through 46° 56′ of latitude in about 13,000 years; by this means the Oural mountains become in the latitude of Mexico and Kamschatka within the tropics. The pole will pass over France and Germany; and then Edinburgh will be due south of London. The author thus accounts for the variation of the magnetic needle, the discovery of tropical fossils in the polar regions, the advance and retreat of the sea, the relative height of mountains, earthquakes, volcanoes, &c."

According to Mr. Mackintosh's theory, all the inhabitants of this earth on some luckless day are to be roasted alive; but, according to the above theory, all the inhabitants of Europe, at least, are to be frozen to death unless they remove their quarters. Edinburgh is to be due south of London in the space of 13,000 years! When this takes place, England will not be troubled with many Scotchmen—they may then blow up the bridge of Berwick, for "Sandy" will still direct his course to the south (a favourite Scotch point of the compass), and will arrive at what is now the polar regions, but which will then be a most delightful climate. But, Mr. Editor, on this subject I should like to have the opinions of some of your scientific correspondents; my present opinion of the matter is, that it is all nonsense.—*Ibid.*

WRITINGS OF ROGER BACON.

The Academie des Sciences Morales et Politiques was on Saturday informed by M. Cousin, that he had just discovered some manuscripts which are important to scholastic and philosophic history. They are writings of Roger Bacon, the celebrated philosopher of the 13th century. Roger Bacon was an Englishman by birth, but passed nearly the whole of his life in France. He became a Franciscan friar, and lived a long time in the convent of the Cordeliers, to which he was confined by order of the General of the Franciscans. This, notwithstanding the silence of Montfaucon and the other bibliographs, induced M. Cousin to believe that there must be manuscripts by Roger Bacon still existing in France. He began by making searches at Douai and St. Omer, where there were formerly English Colleges. These searches have been successful. The only work of Roger Bacon hitherto known is his first letter to Pope Clement IV., which Bacon entitled *Opus Majus*. Clement IV., who protected Bacon, desired that he would give him an exposition of the state of science in the 13th century. Bacon, receiving no answer to his first letter, addressed a new work to the same Pope, under the title of *Opus Minus*. The second letter also remaining unanswered, Bacon remodelled his work, and addressed a third letter to the Pope, which he called *Opus Tertium*. The *Opus Majus* was published at London in 1733. England possesses a manuscript of the *Opus Minus*, and it has hitherto been believed that there was no other in existence; but M. Cousin has discovered at Douai a manuscript containing a considerable fragment of it. This work, in his opinion, is of no great importance. It is not, however, the same with the *Opus Tertium*, which may be considered

as the last words of Roger Bacon; a manuscript of which has been discovered by M. Cousin, and is the only copy to be found in France. He has, besides, recently discovered at Amiens another manuscript by Bacon, the existence of which had never been suspected. It contains questions on the physics and metaphysics of Aristotle. These three manuscripts, of which M. Cousin is preparing a memorial, will throw a light upon the history of scholastic philosophy, and inform us whether or not Roger Bacon was really, as has been asserted, the inventor of the telescope, the microscope, and gunpowder. This is a question which, for want of authentic documents, it has hitherto been impossible to solve.—*French Paper.*

PORCELAIN COLOURS.

The pink colour which ornaments the English porcelain has been hitherto unknown in France, and when required in that country was always bought here. M. Mallagutti, of the manufactory of Sevres, has analysed this colour till he is now able to compose it. In the course of his experiments he discovered another colour similar to crimson lake, which is much more durable than any derived from the animal kingdom, and which may be advantageously employed in oil-painting.—*Mechanics' Magazine.*

BOTANICAL SOCIETY OF LONDON.

A number of botanists, amateurs, &c. have recently held several meetings at the Crown and Anchor Tavern, Strand, for the purpose of forming themselves into a Society, bearing the above title. One striking feature of this Society is, that ladies will be admitted members; this we think highly deserving of commendation, as many ladies are not only excellent botanists, but they can generally devote a considerable portion of time daily to practical botany. Among the leading objects the Society propose are the following:—The advancement of botanical science in general; the particular cultivation of descriptive and systematic botany; the formation of a library, herbarium, and museum; the reading of original papers, extracts, and translations; the exchange of specimens with other societies or individual colections; and every other available means that may promote the objects of the Society. It is further intended that the Society shall consist of the following classes of members; viz. resident, corresponding, honorary, and life members. We are glad to find, among the mighty mass of bricks and mortar, ladies and gentlemen so ardently devoted to so healthy and endearing a pursuit as botany. We shall be happy to hear of their complete success.—*Ibid.*

WIRE FOR MUSICAL INSTRUMENTS.

Sir,—Admiring much the tones of the newly invented musical instrument, the Seraphine, I endeavoured to construct one, and have succeeded in accomplishing the task; but find great disappointment in its not keeping in tune. In making the tongues, or vibrators, I have tried both brass and German silver; the latter producing the finest tones, but subject to the before-named defect. If any of your intelligent correspondents could point out the *best metal* to articulate quick, and stand in tune, and sufficiently flexible as not to be liable to break with the pressure of air during its vibration, and also where it can be be purchased, he would much oblige A MECHANIC. August 30, 1836.—*Ibid.*

BALLOONING ADAPTED FOR INDIA

Sir,—I think that if, as has been lately stated, there are at different altitudes opposite currents of air always blowing in the same direction, aerostation may, nothwithstanding all that has been said about it, prove a pleasant but sure method of travelling to the Continent and back again. Now, as is well known, directly any portion of the atmosphere gets heated, it becomes rarefied, and as such it is lighter than it was before, and consequently it rises, and the cooler air rushes into the space that it before occupied, and thus forms a wind. As the sun may be considered always over the equator, the air directly under it, or that in the middle of the torrid zone must become considerably warmed, and consequently rise, and there must be a corresponding rush of cooler air below from the north and south to supply its place. That there is such, is known in the form of the trade winds, and the reason of their not being due north and south is owing to the whirling of the earth; but the heated air becoming cooled as it ascends, must in the upper regions form an opposite blast to the trade winds; and it has been clearly seen that there is such, by large masses of clouds being observed rapidly moving at a great height in a contrary direction to the wind, at the surface of the earth. A balloon taken to almost any part, within thirty degrees of the equator, would quickly ascertain at what height the change took place, and *ballooning* might prove of utility out there, if it never does in this country. Although the winds near the earth in the temperate zones are not, from various local circumstances, very steady, there is great probability that there may be different currents at some height, and it could be easily ascertained by a few aerial trips made by an experienced person on purpose for that intent.

With respect to guiding balloons by sails, supposing that by placing them obliquely you were enabled to obtain a little side way, it would, I think, be too trifling, compared with the length you would have gone in the same time with the wind, to be of any practical advantage, and to compensate for the greater size and expense of the balloon. It is as unreasonable, in the words of Dr. Ar-

nott, to suppose that an insect, driven along at the rate of eight or ten miles an hour by a river torrent, should have power to stop or sail against the steam, as a man in a balloon by means of wings or sails, could resist or change a motion in the air generally exceeding fifty miles an hour.

I remain Sir,
Your obedient servant,
VINCENT BROWN.

THE

STUDY OF SCIENCE,

A FAMILIAR INTRODUCTION

TO THE

PRINCIPLES OF SCIENCE AND THE ARTS.

CHEMISTRY.

(*Continued from page* 355.)

The following table exhibits a list of all the elementary or simple bodies hitherto discovered, divided into these two classes, namely, the non-metallic elements and the metals; to which are annexed the names of those chemists by whom they were discovered, or by whom their elementary nature was first ascertained, and the date of the discovery.

TABLE OF SIMPLE SUBSTANCES.

		Discoverers.	Date of Discovery.
		I. *Non-metallic Elements.*	
1	Oxygen	Dr. Priestly, in England; and Scheele, in Sweden	1774
2	Chlorine	Scheele, in Sweden	1774
3	Iodine	Courtois, in France	1811
4	Bromine	Balard, in France	1826
5	Fluorine	Properties first accurately investigated by Scheele; but it has never been exhibited in a separate state.	
6	Hydrogen	Cavendish, in England	1766
7	Nitrogen	Dr. D. Rutherford, in Scotland	1772
8	Carbon		
9	Boron	Sir H. Davy, in England	1807
10	Silicon	Berzelius, in Sweden	1824
11	Phosphorus	Brandt, at Hamburgh	1669
12	Sulphur		
13	Selenium	Berzelius, in Sweden	1818
		II. *Metals.*	
14	Potassium	Sir H. Davy, in England	1807
15	Sodium	Sir H. Davy, in England	1807
16	Lithium	Oxide discovered by Arfvedson, in Sweden	1818
17	Baryum	Sir H. Davy, in England	1808
18	Strontium	Sir H. Davy, in England	1808
19	Calcium	Sir H. Davy, in England	1808
20	Magnesium	Bussy, in France	1829
21	Aluminum	Wöhler, in Germany	1828
22	Glucinum	Oxide discovered by Vauquelin, in France	1797
23	Yttrium	Oxide discovered by Gadolin, in Sweden	1794
24	Zirconium	Berzelius, in Sweden	1824
25	Thorium	Berzelius	
26	Cerium	Mosander, in Sweden	1804
27	Tellurium	Klaproth, at Berlin	1797
28	Arsenic	Appears to have been known to Paracelsus, in the 16th century; but first accurately examined by Geo. Brandt, in Sweden	1733
29	Antimony	Known to Basil Valentine	about 1450
30	Chromium	Vauquelin, in France	1797

31	Vanadium	Sefstrom and Berzelius, in Sweden	1830
32	Uranium	Klaproth, at Berlin	1789
33	Molybdenum	Scheele, in Sweden	1778
		Reduced to the metallic state by Hielm	1782
34	Tungsten	MM. D' Elhuyarts, in Spain	1781
35	Columbium	Oxide discovered by Hatchett, in England; and by Ekeberg, in Sweden	1801
		Reduced by Berzelius	1824
36	Titanium	Vauquelin, in France	1796
37	Iron	Known from time immemorial	
38	Manganese	Gahn, in Sweden	1774
39	Nickel	Bergman, in Sweden	1775
40	Cobalt	Brandt, in Sweden	1733
41	Zinc	Henckel mentions its reduction in	1721
42	Cadmium	Stromeyer in Germany	1817
43	Lead	Known from time immemorial.	
44	Tin	Do.	
45	Copper	Do.	
46	Bismuth	Mentioned by Geo. Agricola .. about	1530
47	Mercury	Known from time immemorial.	
48	Silver	Do.	
49	Gold	Do.	
50	Platina	Charles Wood, Assay-master in Jamaica	1741
51	Palladium	Dr. Wollaston, in England	1803
52	Rhodium	The same	1804
53	Iridium	Tenant, in England	1803
54	Osmium		

As some of these elementary bodies enter into the composition of a vast variety of substances of common occurrence, and as it is impossible intelligibly to describe chemical phenomena without the frequent mention of them, or allusion to their properties and modes of action, some short notices of them may here be advantageously introduced, previously to a review of the laws of chemical affinity, and a more extensive description of the simple bodies in general, and of the most important compounds arising from their relative action upon each other. We shall thus avoid the necessity of repeated explanations of the nature of these bodies each time they are mentioned, or the still greater inconvenience of referring to the properties and effects of substances with which the reader may be supposed to be unacquainted.

Among the thirteen non-metallic elements there are some which at all common temperatures exist only in the gaseous state, while the others at moderately low temperatures are solids. The first and most important of the elementary bodies is that called Oxygen, from two Greek words, denoting the *power of producing acids*, because it was formerly thought to be the universal acidifying principle, though it is now known that there are many acids in which oxygen is not contained. One of the grand characteristic properties of this gaseous element is that of being a most powerful supporter of combustion, so that most inflammable bodies burn in it rapidly and brilliantly. Its more peculiar properties will be subsequently described; and we shall only add here that it unites with all other elementary substances (except possibly fluorine), and with many of them in various proportions.

Nitrogen of Azote, is also a gaseous body, the mixture of which with oxygen in certain proportions constitutes atmospheric or common air. The name azote, derived from the Greek, implies its being improper for the purpose of respiration, as animals confined in this gas soon die. It is therefore owing to the oxygen contained in atmospheric air that it is capable of supporting animal life, for none of the higher classes of animals can exist long in any kind of air which does not contain oxygen.

The term Nitrogen has been applied to the gas now under notice, in consequence of its being found to be a constituent part of nitric acid, or as it is vulgarly called, aqua fortis, which is a chemical compound containing a very large proportion of oxygen united to the nitrogen. There are also other compounds of oxygen with nitrogen, among which may be mentioned that sometimes called nitrous oxide, and which, though it contains more oxygen than atmospheric air, may yet be breathed for a time with safety; but it produces very remarkable effects when thus used, generally occasioning a state of excitement somewhat similar to that caused by drinking wine or

spirits, and hence it has been popularly named intoxicating or laughing gas. Nitrogen enters largely into the composition of most kinds of animal matter.

HYDROGEN is likewise a gas, being that which when combined with oxygen forms water, as its name, which is derived from the Greek, implies. It was, when first discovered, called phlogiston, and inflammable air. The former of these terms was attached to it in consequence of an erroneous opinion, at one period generally adopted by chemists, that all metals were composed of various kinds of calces or earths, each respectively united to an inflammable principle named phlogiston. Now as it was observed that when any metal becomes dissolved in a diluted acid as when iron or zinc are thus treated with sulphuric acid and water, inflammable air was always given off during the process, it was conjectured that the air in question was derived from the metal; though it is now known that, in the case proposed, it arises from the decomposition of the water with which the acid is diluted, and that this sort of air never makes its appearance in the course of such metallic solutions, unless water or some other body containing hydrogen be present. This gas, though highly inflammable when mixed with oxygen, and some other simple and compound gases, yet is *incapable of supporting combustion*, for if a burning body, as a lighted candle or match, be introduced into it, the flame will be immediately extinguished.

Hydrogen enters into combination with most other substances, producing many remarkable compounds, among which may be mentioned that formed by its union with nitrogen; the result of which is an alkaline gas, formerly called volatile alkali, and now ammonia. This compound, which at common temperatures exists only in the state of gas, is rapidly absorbed by water or spirit of wine, communicating to it a peculiar pungent odour, with which most persons are familiar, as belonging to spirit of hartshorn and smelling salts.

CHLORINE is the last of the simple bodies existing in a gaseous state at common temperatures; but, while those already mentioned are not only transparent but colourless, this gas exhibits a yellowish-green tint, whence its name chlorine.* It was originally obtained, by Scheele, from the decomposition of muriatic acid, or spirit of salt, in which he found it combined with hydrogen, then called phlogiston; and therefore he gave to the newly-obtained gas the name of dephlogisticated marine acid. It was subsequently supposed to be a compound of muriatic acid, and oxygen; but Sir. H. Davy ascertained its real nature, and gave it its present name.

Chlorine unites with many other simple and compound bodies, forming with several of them acids; and in other respects it exhibits chemical properties analogous to those of oxygen, being like that gas a *supporter of combustion*. It is largely dispersed throughout nature, but always in a state of combination, as in sea-water and rock-salt, or that procured from brine springs, in which it is united with the metal sodium. This gas is by no means adapted for respiration, and when mixed with much atmospheric air it still proves highly irritating, provoking cough and defluxion from the nostrils. As it combines rapidly with many other gases, it has been fouud useful to purify air loaded with infectious miasmata. It is on this account that the chloride of lime, in solution, is used to sprinkle the floors and walls of rooms, and to purify clothes and other articles, which have been tainted by putrid or infectious vapours. Chlorine has alsoa powerful effect in destroying vegetable colours, and the chloride of lime is therefore extensively used in the process of bleaching linen cloth and other substances.

The four preceding bodies, oxygen, hydrogen, nitrogen, and chlorine, exist at common temperatures and pressures only as gas. There are other substances, as, for instance, carbon (charcoal), and the more rare bodies, called silicon and boron, which are found only in the solid state; and some, like iron and most of the metals, though usually solid, become liquefied at respectively various temperatures; and there is still another class of bodies capable of existing under the three several forms of aggregation. Among these last are sulphur, phosphorus, and the substances called bromine, iodine, and selenium, which are of less frequent occurrence.

CARBON is a solid body, hitherto undecomposed and therefore supposed to be elementary, which enters largely into the composition of most substances belonging to the animal and vegetable kingdoms, and which also forms the basis of many of the combustible minerals, as bitumen, coal, plumbago, and amber. In the form of charcoal, procured by charring, or distilling without the access of air, wood and some other substances, carbon is obtained in a

* *Chlore* in French—from the Greek *chloros* the green colour of *young herbage.*

separate state, or merely intermixed with small portions of earths or salts; and it exists in a state of the greatest purity in the diamond; for it has been ascertained, by chemical investigation, that the diamond, when exposed to a very high temperature, and especially if confined in oxygen gas, will burn like charcoal, exhibiting the same product; that gem consisting entirely of crystallized carbon.

(To be continued.)

ELECTRICAL THEORY OF THE UNIVERSE.

By Mr. Thomas S. Mackintosh.

(*Continued from page* 475.)

It is found to be a direct consequence of the law of electrical induction, that "if a small body weakly electrified be placed at a distance from another and a larger body more highly charged with the same species of electricity, it will, as usual, be repelled; *but there is a certain distance within which if it be brought, attraction will take place instead of repulsion.* This happens in consequence of the inductive influence producing so great a change in the distribution of the electricity as to give a preponderance to the attractive forces of the adjacent parts of the two bodies over the repulsive forces that take place in the other parts, and which would have alone acted if the fluid had been immoveable. From this it appears, that when the moon has approached within a certain limit, the repulsive will be overcome by the attractive force, and she will be precipitated upon the earth's surface. We cannot at present pretend to determine this limit, or to speak with any degree of certainty concerning the period that may elapse before this catastrophe takes place. If the principle of this theory were sufficiently investigated to enable us to deduce with precision the electrical states of Jupiter and Saturn, we might perhaps be able to draw conclusions from the respective distances of their satellites with regard to this point; but, in the present state of our knowledge, we can offer no date that could be at all relied upon. However, we will give a table of all the known satellites in the solar system, with their respective distances from their primaries, as affording a reasonable ground of hope, even granting the truth of our theory, that such a catastrophe will not take place for a very considerable period of time.

Mean Distance of the Satellites, the Radius of the Primary being 1.

	1st	2nd	3rd	4th	5th	6th	7th	DISTANCE IN MILES.						
Earth ..	60	..	..	..	..	..	..	235,000	..	..	..	..	..	..
Jupiter ..	5,8-10	$9\frac{1}{4}$	$14\frac{3}{4}$	25,14-20	..	..	..	247,000	397,000	632,000	1,113,000	..	..	..
Saturn ..	3,1-10	3,19-20	4,9-10	$6\frac{1}{4}$	$8\frac{3}{4}$	$20\frac{1}{4}$	59,17-20	124,000	158,000	196,000	250,000	350,000	810,000	2,394,000
Uranus ..	13,1-10	17	19,17-20	$22\frac{3}{4}$	$45\frac{1}{2}$	91	..	129,000	297,000	347,000	379,000	776,000	1,569,000	..

(To be continued.)

GEOLOGY.

FIGURE AND MAGNITUDE OF THE EARTH, ITS MEAN DENSITY, SUPERFICIAL CONFORMATION AND STRUCTURE.

(*Continued from page* 474.)

Before we proceed to describe the present state of the crust of the earth, and investigate the probable causes of its origin and structure, with the nature of the strata or more irregular masses of which it is composed, it will be requisite to notice those facts concerning the general figure, dimensions, and density of the terrestrial globe, and of the contour of its surface, as a body of land and water, for a knowledge of which we are indebted to the researches of astronomers and geographers.

That the figure of the earth is spherical, or rather spheroidal, though a matter of dispute among ancient philosophers, and still disbelieved by the vulgar, is now admitted as an incontestable truth by all well informed persons. The curved surface of the sea when viewed from the shore, and the observation that the upper rigging of an approaching ship becomes visible to a distant spectator before the hull comes in sight, while the hull first disappears when the vessel is receding, prove that the object in question must be moving in the circumference of a great circle.

A similar conclusion may be drawn from the changing aspect of the heavens to an observer travelling from north to south. For though the stars and the constellations they form will be found to maintain the same relative positions with respect to those around them, and the points on which the celestial dome appears to revolve remain unaltered, yet the angle which its axis of revolution forms with the horizon continually lessens; and thus any star, which at the place whence it started, seemed to the observer to have reached its greatest elevation to the south of the point directly above his head, now that he has altered his position, will appear, when highest, on the north of that point; clearly indicating that his path on the earth's surface has not been a right line, but a curve, of which the convexity is turned towards the sky, corresponding, in fact, more or less, with a meridian of longitude. The appearance of the moon when eclipsed, likewise furnishes demonstrative proof of the spheroidal figure of the earth, for lunar eclipses are caused by its circular shadow intercepting the light of the sun from the moon's disk.

It has been found, however, both from astronomical and geodesical observations, that the earth is not a perfect sphere, but that its figure is that of an oblate spheroid, or such a solid as would be formed by the revolution of a fluid mass in open space. Huygens and Newton deduced the real figure of the earth from the doctrine of central forces of bodies revolving in circles, and their conclusions were subsequently verified by actual measurements of degrees of the meridian in various latitudes. It appears, however, that though the polar diameter of the earth is certainly smaller than its equatorial diameter, the exact difference between them has not yet been accurately ascertained. It has been estimated by some at 1-305th part of the equatorial axis, by others at 1-310th part; but Professor Wallace says: "We may assume, without sensible error, that the equatorial axis is to the polar as 334 to 333; the difference, therefore, of the semiaxes, compared with the equatorial radius, will be 1 part in 334. The fraction of 1-334, that is, the difference of the semiaxes divided by the equatorial radius, is called the *compression* of the earth at the poles."*

The determination of the figure of the earth leads to conclusions respecting its mean density, which also has within certain limits been sufficiently ascertained. Sir Isaac Newton, reasoning on the supposition of uniform density in the earth, estimated its compression at the poles as 1-230 of its diameter. Now, since experiment has demonstrated that the compression is less, amounting at most to 1-305, it may be concluded from the observations of Clairault, that if the earth is a spheroid of equilibration, it is denser in the interior than at its surface; and from the experiments of Dr. Maskelyne and Mr. H. Cavendish,* it has been inferred that the mean density of the earth is about five times that of water, and therefore double that of the substances which compose the crust of the earth, collectively considered.

(To be continued.)

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*Murray's Encyclopædia of Geography, 1834, part ii. b. i. ch. 19, p. 128.

"As the earth has a movement of rotation about its axis, all its parts will be animated with a certain degree of centrifugal force, which must be more or less considerable as the parts approach or are distant from the axis. Under the equator will be the points of greatest distance from the axis, and the centrifugal force directly opposed to that of weight or gravitation, ought to reduce the latter there more than at any other place; and at parts intermediate between the poles and the equator, the diminution of weight ought to become less sensible, in propertion as they are nearer the poles. At either pole the centrifugal force will vanish, and bodies will have the same weight as if the earth were at rest.

"As gravity must be normal at the surface of the sea, and as it is the resultant of terrestrial attraction and centrifugal force, it will be obvious that it must vary at different places; and that if the earth was originally a fluid, it could not, in consequence of its rotation, preserve the form of a sphere, but that it must assume that of a flattened spheroid, which would be generated by the revolution of an ellipsis round its smaller axis. This also is demonstrated by experience, and that the flattening at the poles renders the axis 1-310th less than the diameter at the equator."—*Francœur Traité de Mécanique Elémentaire*, 1825, pp. 287, 288. See Scientific Class Book pt. i. *Mechanics*, Nos. 106, 107, and 114 to 123.

* See Scientific Class Book, pt. 1, pp. 40, 41

THE SPIRIT OF THE INDIAN PRESS, OR MONTHLY REGISTER OF USEFUL INVENTIONS, AND IMPROVEMENTS, DISCOVERIES, AND NEW FACTS IN EVERY DEPARTMENT OF SCIENCE.

The following is on the

HISTORY AND CENSUS OF CALCUTTA,

by Captain Birch, from the "*Reformer.*"

"In the year 1998, the English, who had already established themselves in these parts as merchants, and had obtained a *firman* from the Emperor of Delhi, to carry on their commercial transactions, being annoyed by the intrigues of the Dutch, sent their agent, Mr. Walsh, to Prince Azeem Ooshan, one of the grandsons of the Emperor Arungzebe, who was then at the head of affairs in Bengal; and solicited from him, among other privileges, the grant of the villages of Sutanutty, Govindpoor, and Colicotta, *Kali Kurtâ.* After a delay of two years in negociations the above villages were purchased by the Company from the zemindars to whom these places belonged. These possessions extended about three miles on the eastern side of the Bhagurutty river, and about one mile inland. The name Calcutta, some say, was derived from the goddess Kaly, to whom a temple is dedicated, the same which now stands at Kaly-ghat. The English factory, which had been fortified to resist the attacks of the various rebels who disturbed the lower provinces, received about this time the appellation of Fort William, in honour of the then reigning sovereign of England. In consequence of the security afforded to property within the Company's possessions, and facility for trade, several opulent natives were soon induced to make Calcutta their residence. This circumstance, however, excited the jealousy of the Fouzdar of Hooghly, who wanted to send his people to administer justice to the natives, living under the protection of the English flag; but he was prevented by the same means as those which had obtained for the English the oppression of these places, viz. large bribes to the Prince Azeem Ooshan.

About the year 1718, that is ten years after the purchase of the villages of *Kali Kurtâ*, &c. we find the new town in a flourishing state. It was then inhabited by several Portuguese, Armenian, Hindoo, and Mogul merchants, who carried on their commerce under the protection of the English. The shipping in the port at this period amounted to about ten thousand tons. The English Authorities, however, found it necessary to conciliate the Nawab frequently, by presents, in order to carry on their commerce without molestation at the subordinate factories. The security of property and freedom of trade allowed within the English possessions, caused the town to increase in prosperity.

Things continued in this state until Seraj-ood-Dowlah, in 1756, took into his hands the uncontrouled government of Bengal. Among other acts of oppression, he demanded from Rajbullub, the Deputy Governor of Dacca, a large sum of money, and so alarmed him, that he privately sent off his family and property to Calcutta. The refusal of the English to give up to the Nawab Kishenbullub the son of Rajbullub, exceedingly irritated Seraj-ood-Dowlah, and he turned his wrath from every other quarter against the English. One of his first acts of aggression was the taking of the factory at Cossimbazar by force, and imprisoning the Englishmen he found there. He then proceeded directly towards Calcutta. The Hindoo and Mogul merchants residing at Calcutta in vain endeavoured to assuage the anger of the Nawab, who appeared determined to attack Calcutta. At this critical juncture, the English applied for help to the Dutch and the French, who both declined assistance, the latter adding an insulting offer of protection to the English, if they would proceed to Chandernagore. On the 15th of June, 1756, the fort was besieged by the Nawab's troops. This building was situated on the banks of the river: its length from east to west was two hundred and ten yards, its breadth on the south side was one hundred and thirty yards, and on the north only one hundred yards: it had four bastions, mounting each ten guns. The gate-way on the eastern side projected and mounted five guns, and along the river a line of heavy cannon was mounted in embrasures of solid masonry. But as this fort was entirely overlooked by

the buildings in the town, which fell into the hands of the Nawab, resistance became impossible. On the 18th of June the outposts were stormed by the besiegers, which caused the native troops, hired by the English, amounting to 1,500 men, to desert.* The besiegers in a few days obliged Mr. Drake, the governor, to take refuge in a ship then anchored in the river, leaving in the fort 190 Europeans, with Mr. Holwell, one of the members of council at their head. These also wanted to embark, but no ship would come near the fort for fear of the firing kept up by the Nawab's troops. Notwithstanding every effort of the besieged, the fort was taken by storm on the 20th of June, whilst Mr. Holwell was treating with the Nawab the terms of capitulation. The English then surrendered their arms, and the Nawab's people desisted from bloodshed. Having thus got possession of the fort, the Nawab sent for Mr. Holwell, and, after enquiring about the treasures which he said the English had hidden there, dismissed him with assurances of safety. On his return to his companions, who were then 146 persons, he found them surrounded by a strong guard. About 7 o'clock in the evening of the 20th of June, these unfortunate people were locked up in a room used for the confinement of disorderly soldiers, which was not above 20 feet square. The time of the year which is well known for its heat in this climate, and the smallness of the room, caused 123 of these miserable sufferers to expire in the same night. The next morning only 23, among whom was Mr. Holwell, were taken out, scarcely able to stand. The spot, called the black hole, where this room stood, is situated just at the north-west corner of the Tank-square, where at present a triangular patch of grass may be seen. On this spot Mr. Holwell afterwards caused a monument to be erected, which has since been removed.

The Nawab, after a short stay, returned to Moorshedabed, leaving Manick Chund, the Fouzdar of Hooghly, in charge of Calcutta, with a garrison of 3,000 men. Holwell and the other survivors from the black hole were soon after released, and, joining Mr. Drake and those who had taken shelter in the ships, continued there until news having reached Madras, an expedition was proposed against the Nawab, which, conducted by Admiral Watson and Lord Clive, retook Calcutta in January 1757, and though the Nawab brought a large force against them, he could not drive out the English from their possessions. A treaty was the consequence, and since that time to the present, Calcutta has remained in the undisturbed possession of the English, daily increasing in importance, wealth, and prosperity.

The contrast, between the position of Calcutta in 1756, as shewn by the foregoing accounts, and that which it at present occupies as the capital of the most powerful country in Asia, is so striking, that it cannot escape the eye of the most negligent observer. There is no comparison between its present condition and that in which it was at the time to which the above account relates. With the increase of the British possessions the seat of their government has continued to increase, The population of a city, circumstanced as this has been, would, no doubt, increase in proportion. Now, we find, by a report of Mr. Holwell to Mr. Drake, the Governor of Fort William, that the Town of Calcutta was in his time divided into four principal districts, viz. Dee Calcutta, Govindpoor, Sootanutty, and Bazar Calcutta. These four districts contained 5,472½ bigahs of ground, on which the Company received ground rent at three rupees per bigah, per annum, some few places excepted as lakheraje or rent-free lands. Besides the above lands, there was also 3,050 bigahs possessed by proprietors independent of the English; but situate within the bounds of the Company. The number of houses in Calcutta at that time, Mr. Holwell says, was 51,132, and reckoning 8 inhabitants to each house, which he considers a very moderate estimate, he states the number of souls in Calcutta at 4,09,056 as the constant inhabitants of the town, without reckoning those that came in and went out.

In the year 1800, according to the report of the police committee, furnished to Lord Mornington, the population was stated at 5,00,000; and in 1814, according to the calculation of Chief Justice Sir Hyde East, it amounted to 7,00,000. These calculations are supposed by some to have included the suburbs of Calcutta and Garden Reach. But Mr. Holwell's account, which assigns to Calcutta about 4,09,056 inhabitants in 1752, bears out the calculations made in 1800 and 1814. There can be no doubt, as we have stated above, that the population of this city has been on the increase since. Accordingly, at the present moment, the number of souls in Calcutta ought to be considerably more than at the time of Mr. Holwell. But instead of it, we find by the census of Captain Birch, that they amount to 2,29,714 only about one-half the numbers stated by Mr. Holwell. Under these

* It is to be hoped the ruling powers will learn hereby a lesson when Russian invasion is threatened.--*Edit. India Review.*

circumstances we could have been inclined to doubt the correctness of Captain Birch's census; but, by the following statements, we find it apparently borne out:—

In 1821, five assessors were appointed, by whose calculations the population of Calcutta amounted to 1,79,917. But the magistrates in their report calculated as follows.

Upper-roomed houses..........	5,430	× 16	= 86,880	2,30,552
Lower ditto ditto	8,800	× 8	= 70,400	
Tiled huts	15,790	÷4× $5\frac{1}{2}$	= 21,714	
Straw ditto..................	35,497	÷4× $5\frac{1}{2}$	= 51.558	
But making certain allowances their definite calculation was	Resident Inhabitants........			2,05,600
	Influx daily			1,00,000
In 1831, Captain Steel made it				1,87,081

These calculations do not agree with each other, and they differ very widely from the former calculations. But there are two circumstances which make us very doubtful as to the accuracy of the data on which Captain Birch's calculations are based. The one is that Captain Birch states the total number of houses in Calcutta at 65,495, and the total number of occupiers at 2,29,714, which gives an average of a little above 3 souls for each house. Now, according to Mr. Holwell, 8 souls per each is a moderate estimate, and we know it, from personal knowledge, that 5 souls per each house is considered a scanty population in the interior. There can be no doubt that in Calcutta, particularly the Native parts, where the rent is high and many more persons congregated together than in the villages, a higher average, viz. that of Mr. Holwell, would be nearer the truth. Therefore, if we reckon 8 souls per house, which is an opinion we have heard hundreds express, and take for granted that the number of houses stated by Captain Brich is correct, we would have the population, calculated on these data, to amount to (65,495 × 8=) 5,23,260, which is a near approximation to the calculations we have quoted above.

The other circumstance which inclines us to doubt the accuracy of the calculations made by Captain Birch is, that at the time he sent out the Police peons to make the enquiry, people had an impression on their minds, that the Inland and Town duties having been abolished, it was intended to levy some other tax instead, and that the enquiries were being made in order to ascertain the extent to which each house could be taxed. This led the people to mention a much fewer number of inmates than was really the case, and this sort of false report was given more in regard to the females whom they are always anxious to keep out of sight, and who being generally in the purdah, their exact number is much more difficult to ascertain. Hence we believe the males

are stated by Captain Birch at..	144,911
and the females at only........	84,803
	2,29,714

On these grounds we very much doubt the accuracy of the census given by Captain Birch, and the others which approximate to it. We should, however, like to see this question settled on unquestionable data, so far at least as such data are obtainable in a work of this description."

The following observations on STEAM NAVIGATION, by Colonel Chesney, will be read with interest.

"The records kept at Bussora shew that a regular overland communication was maintained from 1792 until 1800 (at least) by means of sailing vessels, leaving this port the 1st of each month; with a mail in duplicate, to be dispatched at the same time for London *from Bussora*, the one viâ Aleppo to Constantinople, and the other through Bagdad to the same city.

The usual time of the sea voyage was a month and a half, during the monsoon and about 24 days the rest of the year. The Dromedaries reached Aleppo (from Bussora) in 11 or 14 days;—13 more are consumed to Constantinople, and about 22 from thence to London.—The communications *back* and *forward*, seem to have been very regular; viz. in about 91 days in the monsoon, and 71 the other 8 months.—4 vessels were employed on this service.

The *Antelope* Brig of	185 Tons.
The *Fly* Galliot of	29 only.
The *Viper* Cutter	90
And the *Abel* Schooner....	85

The mails were opened by the Arabs occasionally in search of gold, but I have only met one instance of a packet being lost.—The whole expense was about 52,000 Rupees; but the actual returns from the letters are not stated: the postage however was 10 Rupees for ¼ of Rupee weight from hence to London.

If despatches were carried in former times through the desert with such a degree of safety, there is no reason why the route might not be resumed just now, with better vessels or, if possible, steamers.—The line

is already established all the way every month from Falmouth to Beirout; and the line of dromedaries now about to be put in operation between the latter place and Mohammerah, will soon decide the question better than mere speculation; but, to try it fairly, there should be a steamer plying between Bombay and Mohammerah; for which one vessel would suffice to *go*; and *come* alternate months. Supposing, therefore, that the *Hugh Lindsay* were to be allotted to this service partially (if not exclusively)—there is nothing more to be done as far as letters are concerned; and a moderate postage would most likely pay *every* expense.

But with reference to public feeling, and convenience, it is to be hoped that something more satisfactory will be attempted when the new steamers reach India.—Three steamers with the assistance of a sailing vessel occasionally, and having two small steamers on the Euphrates at the annual cost of £ 500 each, would, considering the shorter voyage to Mohammerah, enable the Government to open the Red Sea as well, by alternate monthly voyages during the next 18; or, other times as might be sufficient to demonstrate to the world, all the advantages and disadvantages of each: before we establish one of them *permanently*, or both at different seasons, should this be more suitable.

It appears to me that there are several good reasons for opening both routes at the same time.

1st. The three steamers could not keep up a monthly communication to Suez; but, by going the shorter voyage alternately to the Gulph, they might keep up the 12 voyages for a time, say 9 voyages in each direction.

2d. We are not quite sure that either of the routes would be practicable at all seasons, and a continued experiment can alone decide this point, and at the same time the relative speed, expense, &c.

3d. Plague is said to exist in Egypt and Syria almost always at different times, therefore the one might be open whilst the other is shut, either from this cause, or war, disturbances, &c.

4th The commercial and piratical relations of the Persian Gulf, and our interests in Persia itself, require, at least, occasional and regular communications, which would be secured by the double line of the Red Sea and Euphrates; and if neither of them should fully answer our expectations, there will be the resource of experimenting on two others; the one being along the river Tigris to Trebezonde, and from thence by Sea to Constantinople, Malta, and England; whilst the other would be through Persia to Trebezonde, and thence by the Danube and the Rhine to England, which may be said to be almost open already.

The grand object is to have some regular communication or other, but in the present progressive state of steam, we ought to begin with the shortest and cheapest lines possible, looking forward to more daring attempts some 10 or 20 years hence, whence the monsoons may not only be overcome, but *paying* voyages made from Madras and Calcutta to Suez, as well as round the Cape: These objects cannot however be obtained until vessels are constructed to carry fuel at a cheaper rate, and for double the time that has been accomplished as yet; consequently, we ought to be content for the present, with what may be actually practicable from Bombay either to *Suez*, or the *Persian Gulf;* as experience may decide for, or against the latter.

But lest "I should be further tedious to you" I shall merely add that if the Euphrates where only to contribute its mite to the good cause, by being used at such times as the Red Sea may not be available from any cause whatever, it would still deserve some dispassionate consideration, as a mere auxiliary; especially, as great moral and commercial benefits may be the consequence of *renewing* our former intercourse through Arabia: and, after all, it would not be much to boast of, that the subjects of a sailor king, should be able (with the assistance of steam) to do as much as those of Queen Elizabeth did only with sailing vessels,—that is making the Great River a high road to India, where our present Sovereign has, as he feels quite as much at stake, as her Majesty had; and if it had depended upon King William instead of Parliament, both lines would have been in *operation at this instant.—Madras Herald.*"

TO CORRESPONDENTS.

The valuable communications from Mr. Baddeley and Mr. Hodgson have been received.

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